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VOLUME LIII NUMBER 1

# THE ASTROPHYSICAL JOURNAL

AN INTERNATIONAL REVIEW OF SPECTROSCOPY AND ASTRONOMICAL PHYSICS

EDITED BY

GEORGE E. HALE
Mount Wilson Observatory of the Carnegie Institution of Washington

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Yerkes Observatory of the University of Chicago

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Ryerson Physical Laboratory of the University of Chicago

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## JANUARY 1921

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THE
ASTROPHYSICAL JOURNAL
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AND ASTRONOMICAL PHYSICS

VOLUME LIII JANUARY 1921 NUMBER 1

# RADIATION PRESSURE AND CELESTIAL MOTIONS

By HENRY NORRIS RUSSELL

ABSTRACT

*Radial velocities of nebulae.—Various suggested explanations* are shown to be inadequate. (1) The maximum *radiation pressure due to the Galaxy* as a whole is probably less than $2\times10^{-13}$ dynes/cm$^2$. After deriving an expression for the acceleration which this could produce in a spiral nebula of a given apparent diameter, parallax and spectroscopic rotation, it is shown that even on the most favorable assumptions the acceleration of the Andromeda nebula cannot exceed $1.1\times10^{-10}$ cm/sec$^2$., or that of N.G.C. 4594, $1.5\times10^{-13}$ cm/sec$^2$. (2) The *gravitational attraction of the Galaxy* upon these nebulae is probably much greater than the repulsion due to radiation, but it is nevertheless too small to account for their observed radial velocities. (3) And *electrostatic repulsion*, if sufficient to neutralize gravitational attraction, would cause the disruption of the bodies. In fact pressure of any sort could not sensibly alter the motion of a spiral nebula without seriously deforming it.

*Radiation pressure between binary stars* must even in extreme cases be less than one ten-thousandth of the gravitational attraction, and is probably much smaller.

The radial velocities of those spiral nebulae which have so far been observed show a strong preponderance of motions of recession. It has been suggested[1] that this indicates that these nebulae are repelled by the galactic system, and that radiation pressure may be the effective force involved. This hypothesis may easily be tested by quantitative calculations, and the result is found to be decisively against it.

1. *Magnitude of the radiation pressure.*—We are here concerned with the radiation of the galactic system as a whole rather than

[1] H. Shapley, *Astrophysical Journal*, **50**, 133, 1919.

that of individual stars. According to the recent determination by van Rhijn[1] the light which the earth receives from one square degree of the sky (after correction for sources internal to the solar system) varies from 0.010 of that of a first magnitude star, for regions near the galactic pole, to 0.080 at the galactic equator, the average for the whole sky being 0.035. From a point well outside the galactic plane the surface brightness of the Galaxy, viewed normally to its plane, should be twice that of our sky near the galactic pole, or 0.020. We shall probably overestimate the total radiation at such a point if we assume that half the celestial sphere has the average brightness of our sky, 0.035, while the other half is quite dark. The whole radiation from the bright hemisphere will equal that of 720 stars of the first magnitude; but the flux of radiation perpendicular to the diametral plane will be half as great, or equal to 360 stars of the first magnitude, or one star of magnitude $-5.4$. The sun as seen from the earth is of visual magnitude $-26.7$, and the pressure of its radiation upon a black surface normal to it is $4.5\times10^{-5}$ dynes per square centimeter. If the average character of starlight is assumed to be similar to that of sunlight, the radiation pressure due to the galactic hemisphere works out as $1.33\times10^{-13}$ dynes/cm$^2$. Since the luminous efficiency of sunlight is near the maximum, this estimate may be somewhat low. We will therefore adopt $2.0\times10^{-13}$ dynes/cm$^2$ as the radiation pressure due to the light of the Galaxy at an external point not far from it. For points at distances comparable with the diameter of the galactic system, the luminous part of the sky will be less than a hemisphere, and the pressure smaller, and at great distances it will be inversely proportional to the square of the distance.

2. *Assumptions regarding radiation pressure on nebulae.*—The conditions under which radiation pressure may produce the greatest effect in setting a nebula into bodily motion may be summarized as follows:

*a*) The plane of the nebula is perpendicular to the direction of the pressure.

[1] H. Shapley, *Astrophysical Journal*, **50**, 373, 1919.

*b*) The nebula intercepts as much radiation as an opaque circular disk equal in diameter to its own maximum diameter.

*c*) The mass of the nebula is as small as is consistent with known data.

These assumptions will give a superior limit for the influence of radiation pressure. To estimate the mass, we may use the spectroscopic observations, which show that the central portions of some nebulae are rotating substantially like rigid bodies, and assume that the centrifugal force at the periphery of this region is equal to the gravitational attraction of the whole mass. On account of the shape of the nebula, the latter attraction will be somewhat greater than if the mass was concentrated at the center; but this factor will probably be more than balanced by the neglect of radiation pressure inside the nebula, which, in so great a mass, is likely to be important.[1]

Let us now suppose that the radius of this central portion of the nebula is $r$, its extreme outer radius $R$, and its parallax $\pi$ (all in seconds of arc), and that the peripheral velocity at the distance $r$ is $V$ kilometers per second. The true radius of the nebula is then $R/\pi$ astronomical units, or $1.5\times10^{13}\ R/\pi$ cm and its area $7.04\times10^{26}\ R^2/\pi^2$ cm$^2$, so that the whole force of radiation pressure upon it will at most be $F=1.4\times10^{14}R^2/\pi^2$ dynes. The radius of the central region is $1.5\times10^{13}r/\pi$ cm and the velocity at this distance $10^5V$ cm/sec. The mass is $M=\dfrac{v^2r}{G}$, where $v$ and $r$ are expressed in C.G.S. units, and $G$ is the gravitational constant, $6.66\times10^{-8}$. Hence

$$M=2.25\times10^{30}\frac{V^2r}{\pi}\ \text{gm}. \qquad (1)$$

The acceleration produced in this mass by radiation pressure is therefore

$$A=6.3\times10^{-17}\ R^2/V^2r\pi\ \text{cm/sec}^2. \qquad (2)$$

All the quantities which appear in the second member of this equation are approximately known except $\pi$. The smaller the parallax, the greater will be the effect of radiation pressure.

[1] Jeans, *Monthly Notices of the Royal Astronomical Society*, **79**, 328, 1919.

3. *Numerical examples.*—We will now apply these formulae to the two nebulae for which sufficient data exist.

*a*) The great nebula in Andromeda: Pease's spectrograms[1] indicate that the radial velocity along the major axis of this nebula changes by 0.48 km per second of arc from the nucleus, up to a distance of at least 160″. The velocities in the plane of the nebula are probably 1.03 times the radial velocities. We assume therefore $r = 180''$, $V = 90$ km/sec. (which may be too small). For the maximum radius Lundmark[2] gives $R = 3600''$. The parallax is very uncertain. To get a maximum effect we will take Lundmark's value,[3] the smallest that has ever been suggested, $5'' \times 10^{-6}$. We thus obtain the acceleration,

$$A = 1.12 \times 10^{-10} \text{ cm/sec}^2.$$

*b*) N.G.C. 4594.—The radial velocity changes by 2.78 km per second of arc up to a distance of at least 140″.[4] The radial velocities are practically in the plane of the nebula. We therefore let $r = 150''$, $V = 415$ km/sec. From Lundmark's list we have $R = 210''$; $\pi = 7'' \times 10^{-7}$ (the mean of two very discordant estimates). These data give

$$A = 1.53 \times 10^{-13} \text{ cm/sec.}^2$$

The greater of these two accelerations, acting continuously for 100 million years, would produce a velocity of 3.5 km/sec. At the present radial velocity of −316 km/sec., the Andromeda nebula would require $6.5 \times 10^4$ years to traverse the enormous assumed distance of 200,000 parsecs, and radiation pressure during this interval would reduce its velocity by 23 km/sec. For N.G.C. 4594 the corresponding effects are very much smaller. These estimates are probably very much exaggerated. The nebulae in question are by no means as large as the circles which circumscribe them; it is far from certain that they absorb all the radiation that falls upon them; and, above all, their actual parallaxes may be much greater than the assumed values. Moreover, the assumed

[1] *Proceedings of the National Academy of Sciences*, **4**, 24, 1918.

[2] *Kgl. Sv. Vet. Akad. Handlingar*, **60**, 8, 61, 1919.

[3] *Ibid.*, p. 62.

[4] Pease, *Proceedings of the National Academy of Sciences*, **2**, 520, 1916.

distances are so great that it is probable that, seen from such distances, the Galaxy would cover but a small portion of a hemisphere and that its radiation would be correspondingly smaller. It appears therefore safe to conclude that radiation pressure cannot have modified the radial velocities of these nebulae, during the time when they were in the vicinity of the Galaxy, by any important fraction of their present amounts. Though only two nebulae are at present available for discussion, the results are so conclusive as to settle the question.

4. *Comparison with gravitational attraction.*—It must not be forgotten that the stars composing the Galaxy exert a gravitational attraction on the nebulae, as well as a radiation pressure. For any given star the ratio of these two forces is independent of the distance, but varies with the mass and area of the body on which they act. The same will evidently be true of the radiation and gravitation of the galactic system as a whole. At the earth's distance from the sun, the gravitational force is $g=0.592$ dynes per gram, and the radiation pressure $p=4.49\times10^{-5}$ dynes/cm$^2$. For a body of mass $m$ grams, which presents an effective surface $s$ cm$^2$ to the sun's rays, the ratio

$$\frac{g}{p}=1.32\times10^{4}\frac{m}{s} \qquad (3)$$

so that radiation pressure becomes important only for very small particles, as is well known. The corresponding ratio for the Galaxy as a whole will be greater or less than this according as the average emission of radiation per unit mass of galactic matter is greater or less than in the case of the sun. This average value would be hard to estimate; but we may set a superior limit to it by taking the corresponding quantity for the giant stars, which are known to be the brightest in proportion to their mass.

In an investigation by the writer[1] 169 slow binaries of all spectral types from B to M, which gave evidence of being giant stars, were found to have mean absolute magnitude $-0.8$, corresponding to 180 times the sun's light, and an average mass 8.1 times that of the sun, so that the ratio of light to mass is 22 times that for the sun.

[1] For an abstract of some of the results, see *Publications of the American Astronomical Society*, **3**, 327, 1918.

In view of the great numbers of dwarf stars, which give out far less light in proportion to their masses, and the existence of unknown quantities of dark matter, it is probable that the radiation per unit mass for the Galaxy as a whole is much less than this; but, assuming this exorbitant value, we find $g/p = 600\, m/s$.

On the assumptions of section 2, we find for a spiral nebula as a whole $m/s = 3.2 \times 10^3\, V^2 r\pi/R^2$. Introducing the numerical data of section 3, we find for the Andromeda nebula $m/s = 1.8 \times 10^{-3}$ gm/cm$^2$, $g = 1.1p$, while, for N.G.C. 4594, $m/s = 1.3$ gm/cm$^2$; $g = 800\, p$. The computed surface density for the Andromeda nebula is much the smaller of the two, because the "central region" has been assumed to be much smaller in comparison to the whole nebula.

Since all the data have been deliberately chosen so as to exaggerate the importance of radiation pressure, it may be concluded that, in all probability, the gravitation of the galactic system is much more important, in its influence upon the nebulae, than the pressure of its radiation.

5. *Magnitude of the attraction.*—To get a rough idea of this, let us suppose that the mass of the galactic system is equal to $10^{10}$ suns, or $2 \times 10^{43}$ grams (which is four times larger than Jeans's estimate[1]), and that this acts as if concentrated at a point from which distances are measured.

For the Andromeda nebula we have, from (1), $M = \dfrac{3.3 \times 10^{36}}{\pi}$ gms and for N.G.C. 4594 $M = \dfrac{5.8 \times 10^{37}}{\pi}$ gms. The parabolic velocity, $U$, for two bodies of masses $M$ and $m'$, at a distance $r$, is given by the equation $U = \dfrac{G(m+m')}{r}$. For a nebula of parallax $\pi$, $r = \dfrac{3.08 \times 10^{18}}{\pi}$ cm. Introducing $m' = 2 \times 10^{43}$, and the values of $M$ given above for the two nebulae, we find, for the Andromeda nebula, in kilometers per second,

$$U = 6600\ (\pi + 1.6 \times 10^{-7})^{\frac{1}{2}}.$$

Similarly, for N.G.C. 4594, we find $U = 6600\ (\pi + 2.9 \times 10^{-6})^{\frac{1}{2}}$. The parabolic velocity would equal the observed radial velocity of

[1] *Problems of Cosmogony*, p. 222 (1919).

the Andromeda nebula, $-316$ km/sec., if $\pi = 0''.0023$. For N.G.C. 4594, with a radial velocity of $+1180$ km/sec., the corresponding value of $\pi$ is $0''.032$.

There can be no reasonable doubt that the distances of these two nebulae are greater than the limits thus assigned, and it follows that, on the assumptions made, the gravitational attraction of the whole Galaxy is insufficient to produce the observed radial velocities by a fall from infinity, or to prevent the nebulae from receding to an infinite distance. As a large value was purposely taken for the assumed mass of the Galaxy, the conclusion appears trustworthy.

6. *Radiation pressure on stars.*—It has been recently suggested[1] that radiation pressure may nearly neutralize the attraction of the components of certain spectroscopic binaries for one another, or of such a nebula as that in Orion upon the neighboring stars.

For a pair of stars similar to the sun, we have from (3) (introducing $s = 1.52 \times 10^{22}$, $m = 1.98 \times 10^{33}$) $p/g = 5.8 \times 10^{-16}$. Taking now the sun's mass, radius, cross-section, etc., as units, and considering the influence of a star of mass $M_1$, area $S_1$, and surface-brightness $J_1$, upon a companion of mass $M_2$ and area $S_2$, we have

$$p/g = 5.8 \times 10^{-16} J_1 \frac{S_1 S_2}{M_1 M_2}. \qquad (4)$$

Let $a$ be the mean distance of $M_1$ from the center of gravity, $e$ the eccentricity of the orbit, and $y$ the ratio $M_1/M_2$. The periastron distance is $a(1+y)(1-e)$. The sum of the radii of the stars must be less than this; whence $S_1 S_2 < \frac{1}{16} a^4 (1+y)^4 (1-e)^4$. If $P$ is the period in days, we have (remembering that $a$ is measured in solar radii)

$$M_1 + M_2 = 0.013 \frac{a^3 (1+y)^3}{P^2},$$

whence, from (4)

$$p/g < 2.14 \times 10^{-13} \frac{J_1 P^4 (1-e)^4}{a^2 y}.$$

[1] Henroteau, *Journal of the Royal Astronomical Society of Canada*, **14**, 93, 1920.

Let $K$ be the semi-amplitude of variation of radial velocity of the bright star (in km/sec.). Then, in our units

$$a \sin i = 0.0198\, KP(1-e^2)^{\frac{1}{2}}$$

and

$$p/g < 5.5\times 10^{-10} \frac{J_1}{y} \frac{P^2}{K^2} \frac{(1-e)^3}{1+e} \sin^2 i\,. \qquad (5)$$

The last two factors are always less than unity; and $y$ is greater than unity in all spectroscopic binaries for which it can be determined.

Applying (5) to those spectroscopic binaries for which $p/g$ comes out greatest, and introducing plausible (and, on the whole, high) values of $J_1$, we find:

| Star | $P$ | $e$ | $K$ | Spectrum | $J$ | Limit of $p/g$ |
|---|---|---|---|---|---|---|
| | days | | km | | | |
| $\zeta$ Tauri | 138 | 0.18 | 14.95 | $B_3$ | 30. | $6.6\times 10^{-7}$ |
| $\delta$ Canis Majoris | 270 | ..... | 1.5 | F8 | 2. | $3.6\times 10^{-5}$ |
| $\eta$ Boötis | 489 | 0.18 | 8.46 | G | 1. | $8.5\times 10^{-7}$ |
| $\epsilon$ Ursae Majoris | 1510 | 0.31 | 3.5 | A | 10. | $2.5\times 10^{-4}$ |
| $\gamma$ Geminorum | 2175 | 0.30 | 6.12 | A | 10. | $1.8\times 10^{-4}$ |
| $\alpha$ Scorpii | 2120 | 0.20 | 2.12 | Ma | 0.1 | $2.4\times 10^{-5}$ |
| $\alpha$ Orionis | 2220 | 0.24 | 2.45 | Ma | 0.1 | $2.0\times 10^{-5}$ |
| $\epsilon$ Hydrae | 5588 | 0.65 | 8.45 | F8 | 2. | $1.3\times 10^{-5}$ |

The quantities in the last column have still to be multiplied by the factor $\frac{\sin^2 i}{y}$ and also by another (and usually very small) factor arising from the fact that the stars are probably very far from being in contact at periastron. It is therefore evident that radiation pressure between the components of a binary system must in all cases be utterly negligible, in comparison with gravitation.

The whole luminous radiation of the Orion nebula is probably less than that of $\delta$ Canis Majoris (which is at a comparable distance). Unless the mass of the whole nebula is less than that of the star, its gravitational attraction must enormously exceed the pressure of its radiation upon any body of stellar dimensions and mass.

Radiation pressure is doubtless effective on comets' tails, on account of their excessively low mean density, and is also of funda-

mental importance in the interior of giant stars, where the intensity of the radiation is exceedingly great; but it appears to be almost impotent under other circumstances. Eddington[1] has recently shown that it is doubtful whether it is competent to support even so tenuous a structure as a solar prominence.

7. *Deformation of nebulae by pressure.*—It may be shown, more generally, that it is very improbable that any uniform pressure whatever could sensibly affect the motions of spiral nebulae without seriously deforming them.

It is probable that most of the mass is concentrated in the central parts of the nebula, while the pressure will influence mainly the extensive outlying regions. It follows that, under the action of a lateral pressure, the nebula will assume a dished form, convex to the direction from which the pressure comes, so that the gravitational attraction of the central mass upon any outlying portion will have a component perpendicular to the general plane of the nebula, and opposite in direction to the pressure, which balances the difference in the acceleration of the two masses by the pressure itself. These gravitational forces will transfer the momentum imparted by the pressure from the outer regions to the nucleus and cause the whole nebula to move as one mass.

Pressure acting parallel to the plane of the nebula would distort the arms, in this plane, in a similar fashion.

No such distortions are apparent upon the photographs of spiral nebulae; and it appears safe to conclude that, even at the outer edge, the gravitational attraction is fully ten times as great as the effects of any lateral pressure which may be present.

From the data of section 3, the gravitational acceleration at the outer edge of the nebula is found to be $g = 6.66 \times 10^{-4} \frac{V^2 r\pi}{R^2}$ cm/sec.$^2$. Suppose now that the lateral pressure is $q$ dynes per cm. The acceleration which this will produce upon the nebula as a whole is $A = 3.1 \times 10^{-4} \frac{R^2 q}{V^2 r\pi}$ cm/sec$^2$. If $K$ is the ratio of the effective surface density (gm/cm$^2$) for any part of the nebula to the mean surface density for the whole nebula, the acceleration of this part alone under the action of the pressure would be $A/K$. Let $K_1$ be

[1] *Monthly Notices of the Royal Astronomical Society*, **80**, 723, 1920.

the corresponding value for the central region and $K_2$ for the outer edge; then the relative acceleration of the two is $A\left(\frac{1}{K_2}-\frac{1}{K_1}\right)$. This must not exceed one-tenth of $g$, which gives

$$A<6.7\times10^{-5}\frac{V^2r\pi}{R^2}\frac{K_1K_2}{K_1-K_2}.$$

The value of the last factor can hardly be estimated, but it is likely to be small, since $K_1$ is probably considerably greater, and $K_2$ much less, than unity. We have, therefore,

$$A<6.7\times10^{-5}\frac{V^2r\pi}{R^2}.$$

Introducing the numerical values of section 3, we find, for the Andromeda nebula,

$$A<3.5\times10^{-12}\text{ cm/sec}^2.$$

and, for N.G.C. 4594,

$$A<2.5\times10^{-9}\text{ cm/sec}^2.$$

The latter acceleration would require $1.5\times10^9$ years to produce the observed radial velocity of the nebula, and during this time would drive it to a distance of $9\times10^5$ parsecs, which is comparable with the distance assumed above. It might therefore be claimed that the motion of this nebula could be accounted for by a repulsive pressure of some sort; but it should be remembered that several factors, all tending to diminish the pressure effect, have been ignored in the foregoing discussion. The magnitude of the necessary pressure, $3\times10^{-9}$ dynes/cm$^2$, is improbably great, being equivalent to that of radiation of the quality of sunlight, and thirty times as bright as that of the full moon.

For the Andromeda nebula, the greatest permissible pressure is much less than that assumed in section 3, which shows only that the choice among uncertain data, there made with the purpose of exaggerating the influence of radiation pressure, went too far.

The argument of this section assumes that the outer parts of a spiral nebula are permanently associated with the nucleus and in some sort of equilibrium. This is more than dubious; but, if the

arms of the spiral are in process of relatively rapid dissipation into space, the influence of pressure upon the motion of the nucleus must be much less than that calculated above.

8. *Electrical forces.*—Finally, a brief examination may be made of the suggestion that electrical repulsive forces are concerned in the motions of the nebulae.

In view of the distances and velocities concerned, only electrostatic forces need be considered. Here a serious difficulty immediately appears. If the galactic system as a whole and the nebula as a whole are similarly charged, and the electrostatic repulsion between them exceeds the gravitational attraction, then the same should be true of the forces acting between the separate parts of either system, and both should disintegrate. Moreover, the magnitude of the charges and potentials involved is extraordinary. To realize the order of the quantities concerned, suppose that the charge on any body is proportional to its mass, and just sufficient to neutralize the gravitational attraction. The necessary quantity of electricity is $G^{\frac{1}{2}}$ or $2.58\times10^{-4}$ electrostatic units per gram. Consider a spherical mass of radius $r$ and mean density $\rho$. Its total charge will be $\frac{4}{3}\pi\rho r^3G^{\frac{1}{2}}$ e.s.u. Since all bodies of astronomical size behave as conductors, this charge will be concentrated on the surface, with a surface density $\sigma=\frac{1}{3}\rho rG^{\frac{1}{2}}$. The capacity of the sphere is $r$ in electrostatic units, and the potential at the surface will be

$$V=\tfrac{1}{3}\pi\rho r^2G^{\frac{1}{2}} \text{ e.s.u.}$$

At the surface of the sphere there will be an outward pressure $p$, due to the mutual repulsion of the elements of the charge, given by the equation $p=2\pi\sigma^2=\frac{2}{9}\pi\rho^2r^2G$. It is easily verified that this is one-third of the gravitational pressure at the center of the mass, if the latter is homogeneous.

For the earth we have $\rho=5.5$, $r=6.37\times10^8$ cm, whence $V=2.4\times10^{15}$ e.s.u. $=7.2\times10^{17}$ volts! The electrical pressure at the surface comes out $5.75\times10^{11}$ dynes/cm$^2$ or 570,000 atmospheres—which would suffice to tear the surface material loose and blow it away into the depths of space. For bodies of stellar dimensions the results are still more extravagant.

It appears therefore that, even if it were possible to charge bodies of planetary, and much more of stellar, dimensions to such potentials that their electrostatic repulsion equaled their gravitational attraction, they could not retain these charges.

9. The results of this summary survey of the problem indicate that radiation pressure between individual stars is wholly negligible; that such pressures, even under the most favorable assumptions, cannot account for any considerable portion of the observed velocities of the spiral nebulae; or even counteract the gravitational attraction of the Galaxy; that it is extremely improbable that pressure of any sort could set the nebulae in such rapid motion without deforming them to a degree inconsistent with observation; and that electrostatic repulsions appear also to be excluded.

Even the gravitational attraction of the Galaxy appears to be insufficient to account for the magnitude of these velocities—to say nothing of their signs. Two known explanations, at least, remain—the gravitation of a hypothetical huge system of which all the nebulae, and our Galaxy, are but parts, and a relativity effect, depending perhaps on the "curvature" of space as a whole, as discussed by de Sitter.[1] In the writer's opinion, it is more important at present to increase the volume of data available than to postulate the existence of unknown forces to explain the small amount of evidence which we now possess.

PRINCETON UNIVERSITY OBSERVATORY
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[1] *Monthly Notices of the Royal Astronomical Society*, **78**, 28, 1917.

# THE PARALLAXES OF 1646 STARS DERIVED BY THE SPECTROSCOPIC METHOD[1]

By W. S. ADAMS, A. H. JOY, G. STRÖMBERG, AND CORA G. BURWELL

ABSTRACT

*Spectroscopic method of determining absolute magnitude and parallax.*—Some years ago it was discovered that there is a correlation between the relative intensities of certain spectral lines and absolute magnitude for stars of the more advanced spectral types. In the past three years a large number of new trigonometric parallaxes has become available and has enabled this correlation to be established more accurately. For the stars for which trigonometric parallaxes have been determined the absolute magnitudes have been computed directly, but for the Cepheid variables the parallactic motion has been used, and in the case of the giant M stars a combination of results derived from peculiar motion and trigonometric parallaxes. The formulae employed are shown in the text. The absolute magnitudes obtained in this way have been plotted against the relative intensities of certain pairs of lines and from the resulting curves reduction tables have been constructed for each observer. These curves are continuous except in the case of stars of the late K and M types where the division into giants and dwarfs introduces a marked discontinuity. The absolute magnitudes and parallaxes derived by means of these tables are found to have probable errors of $\pm 0.4$ magnitude and $\pm 20$ per cent, respectively. The method used in classifying the spectra and in estimating the intensities of the spectral lines is described.

*Absolute magnitudes and spectroscopic parallaxes of 1646 stars*, including revised values for 495 stars contained in the 1917 list.—An extensive table gives the Boss or Cincinnati number, the name and position of each star, the Harvard visual magnitude, total proper motion, spectral type, absolute magnitude, and spectroscopic parallax. The trigonometric parallax is given, if known.

The determination of the absolute magnitudes of stars from the intensities of certain spectral lines has formed a regular part of the stellar spectroscopic work of the Mount Wilson Observatory during the past five years. Photographs of the spectra obtained for measurements of radial velocity have also been utilized for the calculation of absolute magnitudes, and the lists of stars under observation have been selected with both of these purposes in view.

Since the last publication in 1917, of absolute magnitudes and parallaxes for any considerable number of stars, numerous

[1] *Contributions from the Mount Wilson Observatory*, No. 199.

developments and changes have taken place in the methods used for particular groups of stars and in the material upon which the spectroscopic reductions are based. The rapid increase in the number of parallaxes determined trigonometrically by the photographic method has in particular added greatly to the accuracy of the fundamental values used as the basis of the spectroscopic reductions. They have also made it possible to divide the stars into groups of comparatively small range in spectral type, and thus to secure a continuity in the reduction tables which was not possible when the material was more scanty. With the aid of this large amount of valuable trigonometric parallax material, and the results furnished by computations based on the parallactic and peculiar motions in the case of stars having very small parallaxes, we now feel reasonably certain that a reduction scale has been established which will not require very serious modification in the future. Such corrections as may become necessary when our knowledge of systematic errors in trigonometric parallaxes and of mean parallax relationships is more advanced than at present can probably be applied in the form of tabular modifications of the results given here.

The main purpose of this communication is to place in the hands of astronomers the results in the form of absolute magnitudes and parallaxes so far obtained by the use of the spectroscopic method. For this reason no attempt is made in this place to discuss the bearing of the material on a number of stellar problems. We expect, however, at an early date to supplement this article with a consideration of the evidence afforded by the results on such questions as the giant and dwarf divisions among the stars of the several spectral types, the relationship of parallax to proper motion, the probable systematic errors in parallax determinations, and the motion in space of the stars in the list.

## DERIVATION OF THE REDUCTION TABLES

The general principle employed in the derivation of the reduction tables has been to group the stars according to spectral type and absolute magnitude, using provisional tables for computing the latter, and then to derive systematic corrections to the pro-

visional absolute magnitudes on the assumption that the corrections are constant for the groups in question.

The relative accuracy of the three methods used in computing mean absolute magnitudes—from trigonometric parallaxes, parallactic motions, and peculiar motions—is quite different for the near and the distant stars. For the nearer stars the trigonometric parallaxes give by far the most reliable results, while for stars among which there are no large parallaxes the parallactic motion gives the best result, provided the peculiar motions are small, no selection based upon proper motion has been made, and the group of stars as a whole is at rest relative to the stars in general. For this reason the parallactic motion has been used to compute the mean absolute magnitudes only for very large groups of stars. The result in such cases has been found to agree closely with that derived from trigonometric parallaxes and hence has been used merely as a check upon the latter. Exceptions are the Cepheids and the stars of similar spectral type for which the parallactic motion has been used exclusively.

A peculiar feature is that the parallactic motion for the dwarf stars gives very much larger mean parallaxes than those derived directly from measured parallaxes, probably indicating that these stars as a whole have a velocity differing from that of the stars in general.

The peculiar motion can give accurate results only if the peculiar velocities are large as compared with the solar motion. The results from the peculiar motion are in good agreement with the results from trigonometric parallaxes for all stars fainter than about absolute magnitude +2. For such stars, however, the measured parallaxes are large enough to provide good determinations of the mean absolute magnitudes, and consequently the only case in which the results from the peculiar velocities have been used is that of the giant M stars, for which a combination of the results from trigonometric parallaxes and from peculiar motions has been employed.

The formulae used for computing mean absolute magnitudes from trigonometric parallaxes, parallactic motions, and peculiar motions will now be deduced.

*a*) *Trigonometric parallaxes.*—The following notation has been used:

$\pi$ = true parallax
$\pi_0$ = trigonometric parallax
$\epsilon_0$ = true error of the trigonometric parallax
$M_t$ = true absolute magnitude defined as the apparent magnitude at a distance corresponding to a parallax of 0".1 (10 parsecs)
$M$ = most probable absolute magnitude
$M_1$ = absolute magnitude as given by the provisional reduction tables
$S$ = systematic correction to $M_1$ for reducing it to $M$
$T$ = accidental error of $M_1+S$
$m$ = apparent magnitude
$\pi_1$ = spectroscopic parallax based on $M_1$ as the absolute magnitude

We then have:

$$M_t = M_1 + S + T = m + 5 + 5 \log (\pi_0 + \epsilon_0)$$

and

$$M_1 = m + 5 + 5 \log \pi_1$$

Hence

$$S + T = 5 \log \frac{\pi_0 + \epsilon_0}{\pi_1}$$

or

$$\left.\begin{aligned} &\pi = \pi_0 + \epsilon_0 = \pi_1 \, 10^{0.2(S+T)} = \pi_1 \sigma\tau \\ \text{where} \quad &\sigma = 10^{0.2S} \text{ and } \tau = 10^{0.2T} \end{aligned}\right\} \qquad (1)$$

Further

$$\left.\begin{aligned} &\tau = 10^{0.2T} = 1 + E + \tfrac{1}{2}E^2 + \ldots \\ \text{where} \quad &E = \frac{0.2\,T}{\text{Mod}} = 0.4605\,T \end{aligned}\right\} \qquad (2)$$

We shall limit ourselves in the following to the second order of the error $T$.

From equations (1) and (2) we may deduce an expression for the mean of a number of parallaxes. We shall then make use of the well-known approximate formula

$$\overline{ab} = \bar{a}\,\bar{b}$$

which is valid if the two variables $a$ and $b$ vary *independently* of one another. Since $\pi_1$ is dependent upon $T$ and thus also upon $\tau$ and

$E$, we must separate $\pi_1$ from $\tau$ before taking the arithmetical mean. From equation (1) we obtain

$$\pi_1\sigma=\frac{\pi_0+\epsilon_0}{\tau}=(\pi_0+\epsilon_0)(1-E+\tfrac{1}{2}E^2)$$

From this equation we deduce

$$\pi_1\sigma-\pi_0 A=\epsilon_0-\pi E \tag{3}$$

where

$$A=1+\tfrac{1}{2}E^2 \tag{4}$$

In the following we shall assume that the errors $\epsilon_0$ and $T$, and hence also $E$, have a normal error-distribution.

Taking the arithmetical mean of a number of equations of form (3) we obtain

$$\overline{\pi_1\sigma}-\bar{\pi}_0\bar{A}=0 \text{ or } \frac{\overline{\pi_1\sigma}}{\bar{A}}=\bar{\pi}_0=\bar{\pi} \tag{5}$$

where

$$\bar{A}=1+\tfrac{1}{2}\overline{E^2}>1 \tag{6}$$

The quantity $\pi_1\sigma$ is the parallax corresponding to the most probable absolute magnitude $M=M_1+S$. The mean of a series of these parallaxes is not exactly equal to the mean of the corresponding trigonometric parallaxes, but is systematically larger. This fact depends upon the unequal effects produced in the spectroscopic parallax by a positive and a negative error of the same size in the estimation of the absolute magnitude.

In order to make the spectroscopic parallaxes directly comparable with the trigonometrical ones, we shall define the quantity $\frac{\pi_1\sigma}{\bar{A}}$ as the spectroscopic parallax $\pi'$, and in the first instance determine the quantity $\frac{\sigma}{\bar{A}}$. The absolute magnitudes corresponding to these spectroscopic parallaxes have been denoted by $M'$ and are those given in the catalogue.

We then have

$$M'=m+5+5\log\pi_1\sigma-5\log\bar{A}$$

$$M'=m+5+5\log\pi'$$

The most probable absolute magnitude $M$ defined in such a way that a positive and a negative error $T$ have the same probability is related to $M'$ by the equation

$$M = M' + 5 \log \bar{A} \tag{7}$$

and

$$\bar{A} = 1 + \frac{0.02\,\theta^2}{\text{Mod}^2} \tag{8}$$

where $\theta$ is the mean error in an estimate of the absolute magnitudes.

In the determination of $\frac{\sigma}{\bar{A}}$ we start from the equations of condition (3)

$$\pi_1 \sigma - \pi_0 A = \epsilon_0 - \pi E$$

If the range in the values of $\pi_1$ is small, we may find $\frac{\sigma}{\bar{A}}$ by taking arithmetical means of equations (3) multiplied by the relative weights $p$ of the trigonometric parallaxes:

$$\frac{\sigma}{\bar{A}} = \frac{\Sigma p \pi_0}{\Sigma p \pi_1} \tag{9}$$

If the range in $\pi$ is considerable, we do not utilize to their full extent the higher weights of the larger parallaxes by using equation (9). An ordinary least-squares solution might give erroneous results on account of the effect of large values in the errors $E$ and $\epsilon_0$. For this reason we have in general used a compromise between the direct mean of the equations of condition as given by (9) and the ordinary least-squares solution based upon the weighting of the errors $\epsilon_0$. Dividing the results into three or four groups according to the size of $\pi_1$, we have as in (9)

$$\left.\begin{aligned} &\frac{\sigma}{\bar{A}} \Sigma p \pi_1 - \Sigma p \pi_0 = 0 \\ &\text{Weight} = \frac{1}{k^2 \Sigma p + \dfrac{\eta^2 (\Sigma p \pi_0)^2}{n}} \end{aligned}\right\} \tag{10}$$

where $k$ is the mean error of the trigonometric parallaxes corresponding to unit weight, $n$ is the number of stars, and

$$\eta^2 = \bar{E}^2 = \frac{0.04\,\theta^2}{\text{Mod}^2}$$

If we assume definite values of $k$ and $\eta$ we can make an ordinary least-squares solution of equations (10). The values of $k$ and $\eta$ used are

$k = \pm 0''.015$, corresponding to a probable error in $\pi_0$ of $\pm 0''.010$

$\eta = \pm 0.205$, corresponding to a probable error in $M_1 + S$ of $\pm 0.3$

In order to secure a grouping independent of the errors in the estimates of the absolute magnitudes, a solution was made using the proper motions reduced to zero apparent magnitude as a basis of the grouping. In this case there is less danger of a systematic effect upon the sums $\Sigma T$ and $\Sigma E$ which we have to suppose to be equal to zero.

In the first computation of the systematic correction to the provisional reduction tables all available trigonometric parallaxes for stars in the list were used. The reductions to absolute parallaxes were generally computed from the apparent magnitudes of the comparison stars, using the table given by Kapteyn in *Groningen Publications*, No. 24, page 15. For the parallaxes determined at the Allegheny, McCormick, and Sproul observatories a constant reduction of $+0''.005$ and for the Mount Wilson parallaxes one of $+0''.002$ has been applied throughout. The weights of the different determinations based upon the size of the probable errors are as follows:

| | | | |
|---|---|---|---|
| Mount Wilson | 1.5 | Vôute | 0.5 |
| Greenwich | 1.5 | Abetti | 0.4 |
| Allegheny | 1.0 | Russell | 0.3 |
| McCormick | 1.0 | Peter | 0.3 |
| Sproul | 1.0 | Jost | 0.3 |
| Yerkes | 1.0 | Kapteyn | 0.4 |
| Yale | 0.5 | Flint I | 0.05 |
| Fox | 1.0 | Flint II | 0.2 |

A second approximation was made using only the parallaxes determined at the Allegheny, McCormick, Yerkes, and Mount Wilson observatories, all being given the same weights. Slight corrections based on this latter computation were then applied to the tables resulting from the first approximation. In the final analysis the reduction tables are thus based almost exclusively on

the four series of trigonometric parallaxes mentioned above. The differences between the two solutions are, however, very small.

*b*) *Parallactic motion.*—The co-ordinates of a star in space relative to the sun and referred to the equatorial system of co-ordinates are

$$\left.\begin{aligned} X &= r \cos \alpha \cos \delta \\ Y &= r \sin \alpha \cos \delta \\ Z &= r \sin \delta \end{aligned}\right\} \tag{11}$$

where $r$ is the distance from the sun and $\alpha$ and $\delta$ are the right ascension and declination of the star. Differentiating these equations with respect to the time, we obtain the velocity components $x$, $y$, and $z$, in km per second relative to the sun.

$$\left.\begin{aligned} x &= V \cos \alpha \cos \delta - \frac{k}{\pi}(\mu_1 \sin \alpha + \mu_2 \cos \alpha \sin \delta) \\ y &= V \sin \alpha \cos \delta + \frac{k}{\pi}(\mu_1 \cos \alpha - \mu_2 \sin \alpha \sin \delta) \\ z &= V \sin \delta + \frac{k}{\pi}\mu_2 \cos \delta \end{aligned}\right\} \tag{12}$$

where

$V$ = radial velocity

$\pi$ = parallax

$\mu_1 = \mu_\alpha \cos \delta$

$\mu_2 = \mu_\delta$

$\mu_\alpha$ and $\mu_\delta$ = annual proper motion in $\alpha$ and $\delta$ in seconds of arc

$$k = \frac{\text{astronomical unit of length in km}}{\text{number of seconds in a year}} = 4{\cdot}737$$

Introducing the velocity components $x_0$, $y_0$, and $z_0$ of the sun relative to the geometrical centroid of a large number of stars, we have

$$x + x_0 = \epsilon_1, \qquad y + y_0 = \epsilon_2, \qquad z + z_0 = \epsilon_3$$

where $\epsilon_1$, $\epsilon_2$, and $\epsilon_3$ are the peculiar velocity components of the star referred to this centroid.

If we use the same co-ordinates for the sun's apex for all spectral types and absolute magnitudes and adopt the values computed

for the stars of later type given in *Mount Wilson Contributions*, No. 144, page 14,

$$\alpha_0 = 270^\circ.9, \qquad \delta_0 = +29^\circ.2, \qquad V_0 = 21.48 \text{ km/sec.}$$

we find

$$x_0 = +0.28, \quad y_0 = -18.75, \quad z_0 = +10.48$$

The following auxiliary quantities have been tabulated:

$$\left.\begin{aligned} A_0 &= x_0 \sin\alpha - y_0 \cos\alpha \\ B_0 &= x_0 \cos\alpha \sin\delta + y_0 \sin\alpha \sin\delta - z_0 \cos\delta \end{aligned}\right\} \tag{13}$$

We can then derive

$$\left.\begin{aligned} \frac{k\mu_1}{\pi} - A_0 &= \epsilon' \\ \frac{k\mu_2}{\pi} - B_0 &= \epsilon'' \end{aligned}\right\} \tag{14}$$

The quantities $\epsilon'$ and $\epsilon''$ are the components of the peculiar velocities of the stars on two axes perpendicular to the line of sight in the direction of increasing right ascension and declination.

In order to obtain the mean absolute magnitude we may proceed in the following way, the notation being the same as in the discussion of the trigonometric parallaxes:

$$\pi = 10^{0.2(M_1+S+T-m)-1} = \frac{0.1\,\sigma\tau}{\rho}$$

where

$$\sigma = 10^{0.2S}$$
$$\tau = 10^{0.2T}$$
$$\rho = 10^{0.2\,(m-M_1)}$$

Equations (14) may then be written

$$\frac{10k\mu_1\rho}{\sigma\tau} - A_0 = \epsilon', \qquad \frac{10k\mu_2\rho}{\sigma\tau} - B_0 = \epsilon'' \tag{15}$$

The components of the proper motions $\mu_1$ and $\mu_2$, however, are affected by systematic and accidental errors. The systematic corrections given by Boss in his *Catalogue*, page xxviii, have been

applied.[1] Denoting the accidental errors in $\mu_1$ and $\mu_2$ by $\eta_1$ and $\eta_2$ we can write equations (15) in the following form:

$$\left.\begin{aligned} \frac{A_0\sigma\tau}{10k}-\mu_1\rho&=\rho\eta_1-\frac{\sigma\tau\epsilon'}{10k}\\ \frac{B_0\sigma\tau}{10k}-\mu_2\rho&=\rho\eta_2-\frac{\sigma\tau\epsilon''}{10k}\end{aligned}\right\} \tag{16}$$

As in the case of the trigonometric parallaxes, we shall write $\tau$ in the form

$$\tau=1+E+\tfrac{1}{2}E^2=A+E$$

The equations of conditions are then

$$\left.\begin{aligned} A_0x-\mu_1\rho&=\rho\eta_1-\frac{\sigma\epsilon'}{10k}-\frac{\sigma A_0E}{10k}\\ B_0x-\mu_2\rho&=\rho\eta_2-\frac{\sigma\epsilon''}{10k}-\frac{\sigma A_0E}{10k}\end{aligned}\right\} \tag{17}$$

where

$$x=\frac{A\sigma}{10k}=\frac{(1+\frac{1}{2}E^2)\sigma}{10k}$$

The first terms on the right-hand side of these equations increase with the apparent magnitude. The second terms are usually the largest, while the existence of the third terms tends to decrease the weights for stars farthest from the apex and antapex. In order to make the weights more uniform we have in the case of the distant stars limited ourselves to those brighter than apparent magnitude 5.5. At the same time this limitation decreases the effect of a selection among these stars according to proper motion, since nearly all can be assumed to be selected on account of brightness alone. In order to reduce the effect of large peculiar motions and large accidental errors in the absolute magnitudes, we have collected the equations of condition (17) into a few groups according to the size of $A_0$ and $B_0$, formed means, and given each of these new equations of condition a weight according to the number of stars.

The new equations of condition are then

$$\left.\begin{aligned} \overline{A_0}x-\overline{\mu_1\rho}&=0\\ \overline{B_0}x-\overline{\mu_2\rho}&=0\end{aligned}\right\} \quad \text{Weight } N \tag{18}$$

[1] The *Catalogue*, however, gives the total proper motion without these corrections.

When $x$ has been found from the solution of equations (18) we have

$$\sigma\bar{A} = 10kx$$

and

$$\frac{\sigma}{\bar{A}} = \frac{10kx}{\bar{A}^2} \tag{19}$$

The mean absolute magnitude $M'$ used for computing the most probable parallaxes can then be obtained by adding the quantity

$$5 \log \frac{\sigma}{\bar{A}} = 5 \log x + 5 \log k + 5 - 10 \log \bar{A}$$

to the mean of the provisional magnitudes $\overline{M}_1$, a provisional value of $\bar{A}$ being used.

This method of deriving mean absolute magnitudes from the components of the parallactic motions requires less computation than that based upon the total parallactic motion. It is similar to that used by Charlier in his study of the B stars.[1] The systematic correction to the absolute magnitudes due to the errors in the estimates of the latter that must be applied in order to obtain the most probable parallaxes ($-10 \log \bar{A}$) has a tendency to make the parallaxes smaller. This would probably account for the difference found in the mean parallax of the B stars when based on the one hand upon the assumption of equality of the absolute magnitudes, and on the other directly upon the proper motions (Kapteyn, Plummer, Bergstrand, and others).

*c*) *Peculiar motion.*—From equations (16), limiting ourselves to terms of the first order in the errors, we derive

$$\left.\begin{aligned} \xi\mu_1\rho - A_0 &= \epsilon' - \xi\eta_1\rho + A_0E \\ \xi\mu_2\rho - B_0 &= \epsilon'' - \xi\eta_2\rho + B_0E \end{aligned}\right\} \tag{20}$$

where

$$\xi = \frac{10k}{\sigma}$$

From the radial velocities corrected for the sun's motion we can compute for definite groups of stars the average radial velocity

[1] *Meddelanden från Lunds Astronomiska Observatorium*, Ser. II, No. 14.

$\frac{\Sigma|V'|}{n}$. This quantity can be supposed to be nearly identical with $\frac{\Sigma|\epsilon'|}{n}$ or $\frac{\Sigma|\epsilon''|}{n}$.

Assuming the dispersion in $\epsilon'$ and $\epsilon''$ to be considerably larger than in the other terms on the right-hand sides of equations (20), we derive

$$\left.\begin{aligned}\Sigma|\xi\mu_1\rho - A_0| &= \Sigma|\epsilon'| + \frac{\xi^2\overline{\eta_1^2}\bar{\rho}^2 + A_m^2\overline{E}^2}{2\Sigma|\epsilon'|}n^2 \\ \Sigma|\xi\mu_2\rho - B_0| &= \Sigma|\epsilon''| + \frac{\xi^2\overline{\eta_2^2}\bar{\rho}^2 + B_m^2\overline{E}^2}{2\Sigma|\epsilon''|}n^2\end{aligned}\right\} \tag{21}$$

where $A_m$ and $B_m$ denote the average numerical values of $A_0$ and $B_0$, $\overline{\eta_1^2}$ and $\overline{\eta_2^2}$ are the squares of the mean errors in the measurements of the component of proper motion, $\mu_\alpha \cos\delta$ and $\mu_\delta$, and $n$ is the number of stars. Since the results from the peculiar motions were used only for the giant $M$ stars where the peculiar velocities are large, it was found that the second terms in the right-hand members could be neglected. Equations (21) then reduce to the more simple form

$$\left.\begin{aligned}\Sigma|\xi\mu_1\rho - A_0| &= \Sigma|\epsilon'| \\ \Sigma|\xi\mu_2\rho - B_0| &= \Sigma|\epsilon''|\end{aligned}\right\} \tag{22}$$

The average radial velocities corrected for the solar motion, for the $K$ term, and for the effect of stream motion were then computed and the values of $\Sigma|\epsilon'|$ and $\Sigma|\epsilon''|$ obtained from them. Equations (22) were then solved by assuming approximate values of $\xi$ and computing the corrections to these values. The results thus obtained were nearly the same as those found from computing geometrical mean parallaxes from the $\tau$ and $v$ components according to the method devised in *Mount Wilson Contributions*, No. 144, page 7.

## REDUCTION CURVES

The values of $\Delta M_1 = 5 \log \frac{\sigma}{A}$ having been computed for groups of stars of different spectral types and absolute magnitudes, according to formulae (10), (18), and (22), the sums $M_1 + \Delta M_1 = M'$ were

properly weighted and plotted against the mean intensities of the several spectral lines used in the determination. When the correlation curves were computed, a continuous change of absolute magnitude with line-intensity and with spectral type was found

TABLE I

| $\frac{4077}{4072}$ | Fo | F8 | $\frac{4215}{4250}$ | F8 | G4 | Ko | K4 | K8 | M |
|---|---|---|---|---|---|---|---|---|---|
| ..... | ..... | ..... | +5.0..... | −2.9 | −2.4 | −1.7 | −0.6 | −2.9 | ..... |
| +3.0..... | −0.5 | −0.3 | +4.0..... | −1.4 | −0.8 | +0.4 | −0.2 | −1.6 | ..... |
| +2.0..... | +1.1 | +1.5 | +3.0..... | +0.1 | +0.6 | +2.7 | +0.3 | −0.4 | ..... |
| +1.0..... | +2.3 | +2.4 | +2.0..... | +1.7 | +2.0 | +3.7 | +1.2 | +0.5 | ..... |
| 0.0..... | +3.0 | +3.3 | +1.0..... | +3.2 | +3.8 | +4.4 | +6.0 | ..... | ..... |
| −1.0..... | +3.8 | +4.3 | 0.0..... | +4.8 | +5.1 | +5.2 | +6.5 | +7.2 | ..... |
| −2.0..... | +4.3 | +5.0 | −1.0..... | +6.4 | +6.1 | +6.1 | +7.2 | +8.2 | + 9.0 |
| ..... | ..... | ..... | −2.0..... | ..... | ..... | +6.9 | +7.9 | +9.4 | +11.4 |

| $\frac{4290}{4271}$ | Fo | F8 | $\frac{4454}{4461}$ | F8 | G4 | Ko | K4 | K8 | M |
|---|---|---|---|---|---|---|---|---|---|
| ..... | ..... | ..... | −2.0..... | ..... | ..... | −2.7 | 0.0 | ..... | ..... |
| +2.0..... | +0.5 | +0.3 | −1.0..... | −1.6 | −1.1 | +2.8 | +1.2 | ..... | ..... |
| +1.0..... | +2.0 | +1.6 | 0.0..... | +3.0 | +3.8 | +4.9 | +5.5 | ..... | ..... |
| 0.0..... | +2.9 | +2.5 | +1.0..... | +5.5 | +5.8 | +5.9 | +6.2 | ..... | ..... |
| −1.0..... | +4.1 | +3.7 | +2.0..... | ..... | +6.7 | +6.5 | +6.7 | +7.1 | + 7.2 |
| −2.0..... | +4.3 | +4.7 | +3.0..... | ..... | ..... | +6.7 | +7.3 | +7.7 | +7.8 |
| −3.0..... | ..... | +5.0 | +4.0..... | ..... | ..... | ..... | +7.7 | +8.3 | +8.4 |
| ..... | ..... | ..... | +5.0..... | ..... | ..... | ..... | ..... | +8.8 | +9.0 |
| ..... | ..... | ..... | +6.0..... | ..... | ..... | ..... | ..... | +9.1 | +9.9 |
| ..... | ..... | ..... | +7.0..... | ..... | ..... | ..... | ..... | ..... | +10.8 |
| ..... | ..... | ..... | +8.0..... | ..... | ..... | ..... | ..... | ..... | +11.1 |

| | | | $\frac{4454}{4494}$ | F8 | G4 | Ko | K4 | K8 | M |
|---|---|---|---|---|---|---|---|---|---|
| ..... | ..... | ..... | 0.0..... | ..... | −3.0 | −0.4 | +0.4 | ..... | ..... |
| ..... | ..... | ..... | +1.0..... | +1.9 | +2.4 | +4.0 | +1.6 | ..... | ..... |
| ..... | ..... | ..... | +2.0..... | +5.1 | +5.4 | +5.5 | +6.0 | ..... | ..... |
| ..... | ..... | ..... | +3.0..... | ..... | +6.5 | +6.2 | +6.4 | +6.8 | ..... |
| ..... | ..... | ..... | +4.0..... | ..... | ..... | +6.5 | +6.8 | +7.3 | + 7.3 |
| ..... | ..... | ..... | +5.0..... | ..... | ..... | ..... | +7.2 | +7.8 | + 7.9 |
| ..... | ..... | ..... | +6.0..... | ..... | ..... | ..... | ..... | +8.4 | + 8.5 |
| ..... | ..... | ..... | +7.0..... | ..... | ..... | ..... | ..... | +8.8 | + 9.2 |
| ..... | ..... | ..... | +8.0..... | ..... | ..... | ..... | ..... | +9.1 | +10.0 |
| ..... | ..... | ..... | +9.0..... | ..... | ..... | ..... | ..... | +9.5 | +10.7 |
| ..... | ..... | ..... | +10.0..... | ..... | ..... | ..... | ..... | ..... | +11.0 |

except in the case of stars of the late K and M types, where the division into giants and dwarfs caused a marked discontinuity. The scale used in the estimates of the line-intensities being an arbitrary one, different reduction tables were computed for the three

observers, Adams, Joy, and Miss Burwell. An abstract of the tables for Mr. Adams' scale is given below. The differences of intensity for the pairs of lines employed are given under their wave-lengths and the corresponding absolute magnitudes under the successive spectral types.

Among the giants the rate of change of absolute magnitude with line-intensity is very large in the case of the line 4454, and for this reason the two estimates of this line whenever made have been given half-weight.

### PROBABLE ERRORS OF THE ABSOLUTE MAGNITUDES

A determination of the probable errors of the absolute magnitudes has been made using the trigonometric parallaxes for this purpose.

Equation (3) can be written

$$\pi' - \pi_0 = \epsilon_0 - \pi E = v$$

where $\pi'$ is the most probable spectroscopic parallax.

Calling the weights of the trigonometric parallaxes $p$, we find

$$\overline{E^2} = \frac{\Sigma p v^2 - nk^2}{\Sigma p \pi_0^2 - nk^2} \qquad (23)$$

where $k$ is the mean error of a parallax of weight unity.

If a star has been measured by several observers, the error in the trigonometric parallax becomes smaller, but the error in the spectroscopic parallax is unaffected. It is, therefore, necessary in some way to equalize the weights of the trigonometric parallaxes, and we have used the method of giving all stars for which the weight is equal to 1 or larger the weight unity, omitting all parallaxes of smaller weights. As before, the unit of weight has been assumed to be such as would correspond to an external probable error of $\pm 0''.010$. Calling the mean error of the absolute magnitudes $\theta$, we have

$$\theta^2 = 25 \text{ Mod}^2 \, \overline{E^2} = 4.715 \overline{E^2}$$

The following table gives the values of the probable errors $r$ computed by this method:

TABLE II

| Spectrum | *M* | Number | *r* | Spectrum | *M* | Number | *r* |
|---|---|---|---|---|---|---|---|
| A–F4 | < 2.0 | 28 | ±0.30 | G5–G8 | < 1.0 | 42 | ±0.51 |
| | 2.1 to 3.0 | 31 | .58 | | 1.1 to 5.0 | 30 | .38 |
| | > 3.0 | 25 | .42 | | > 5.1 | 24 | .25 |
| F5–F8 | < 3.5 | 38 | ±0.34 | G9–K4 | < 1.0 | 59 | ±0.32 |
| | > 3.6 | 48 | .38 | | 1.1 to 3.0 | 27 | .53 |
| | | | | | 3.1 to 6.0 | 33 | .46 |
| F9–G4 | < 4.0 | 42 | ±0.64 | | > 6.1 | 38 | .36 |
| | 4.1 to 5.0 | 39 | .12 | | | | |
| | > 5.1 | 18 | .46 | K5–K9 | < 2.0 | 23 | ±0.00 |
| | | | | | > 7.5 | 25 | .24 |
| | | | | M | < 3.0 | 33 | ±0.00 |
| | | | | | > 7.0 | 17 | .20 |

When the probable error is equal to 0.00, the residuals are smaller than those due exclusively to the effect of a probable error ±0″.010 in the trigonometric parallaxes.

For the sake of convenience we may assume a probable error in the absolute magnitudes of ±0.40 throughout. The corresponding value of $\bar{A}$ is then

$$\bar{A} = 1 + \frac{\bar{E}^2}{2} = 1 + \frac{0.02 r^2}{0.455 \text{ Mod}^2} = 1.0373$$

The correction which must be applied to the absolute magnitudes $M'$ given in the table, in order to convert them into the most probable ones, is therefore (equation 7)

$$5 \log \bar{A} = +0.08$$

The probable errors $r'$ of the spectroscopic parallaxes can be computed from the formula

$$r' = \frac{r}{5 \text{ Mod}\, \pi}$$

If

$$r = \pm 0.40$$

we find

$$r' = \pm 0.184\, \pi$$

In other words, the probable error of the spectroscopic parallaxes is somewhat below 20 per cent of the parallax itself.

## EFFECT OF SYSTEMATIC ERRORS IN THE TRIGONOMETRIC PARALLAXES

Several studies of the systematic difference between various series of trigonometric parallaxes have been made recently. A special solution has been undertaken, applying the systematic corrections derived by van Maanen and Miss Wolfe (*Mt. Wilson Contr.*, No. 189) for reduction to a mean system. The most important of these corrections is that of $+0''.0027$ to the Allegheny parallaxes,[1] which, on account of their large number and high weight, has a tendency to make the spectroscopic parallaxes larger. The effect upon the absolute magnitudes, if these corrections were applied to the measured parallaxes, can be seen from the following table:

TABLE III

| Spectrum | A–F8 | F9–G8 | G8–K4 | K5–K9 | M |
|---|---|---|---|---|---|
| Giants..... | +0.03 | +0.09 | +0.06 | 0.00 | +0.03 |
| Dwarfs..... | +0.05 | +0.04 | +0.03 | +0.01 | +0.03 |

The spectroscopic parallaxes would then be increased by a quantity equal to $(10^{0.2\Delta M} - 1)$. It thus appears that the systematic effect arising from this source is very small.

## COMPARISON WITH TRIGONOMETRIC PARALLAXES

A direct computation of the difference, spectroscopic *minus* trigonometric parallax, has been made for the stars whose parallaxes have been determined at the Allegheny, McCormick, Yerkes, and Mount Wilson observatories. The algebraic mean difference, assigning all the stars the same weight, is given in the third column of the following table, while the weighted mean difference is given in the fourth column. The weights are here based upon the facts that the errors in the spectroscopic parallaxes are proportional to the parallaxes themselves, while the errors in the trigonometric

[1] The correction given in the paper cited is $+0''.0042$, which is a mean of two determinations. A mean reduction to absolute parallax of $+0''.0035$ was used, while in the present system we have used $+0''.005$, which accounts for the difference.

parallaxes are independent of this. The quantity $S'$ is computed from the equations of condition

$$S'=\pi'-\pi_0, \quad \text{weight } \frac{1}{\bar{\epsilon}_0^2+\bar{E}^2\pi^2}$$

where the errors in the trigonometric parallaxes and the absolute magnitudes are based upon the probable errors $\pm 0''.010$ and $\pm 0.4$, respectively. We have then

$$\bar{\epsilon}_0^2=0.00022, \; \bar{E}^2=0.0746$$

TABLE IV

| | Number | Not Weighted $S$ | Weighted $S'$ |
|---|---|---|---|
| Allegheny | 296 | $+0''.0018$ | $+0''.0031\pm0''.0007$ |
| McCormick | 209 | $-0.0008$ | $+0.0020\pm0.0010$ |
| Yerkes | 98 | $+0.0019$ | $+0.0016\pm0.0015$ |
| Mount Wilson | 79 | $-0.0030$ | $-0.0032\pm0.0011$ |
| | 682 | $+0''.0005$ | |

It is to be noted that in computing the reduction tables the larger parallaxes have the highest weights, so that we cannot expect $S$ and still less $S'$ to become zero when all the stars are taken together.

The weighted means $S'$ can be supposed to represent the systematic corrections to the trigonometric parallaxes, if these corrections can be regarded as constant. They agree well with those found by van Maanen and Miss Wolfe except in the case of the McCormick parallaxes. The difference between the weighted mean $S'$ and the unweighted mean $S$ shows a dependence upon the size of the parallax, which can hardly be due to the spectroscopic parallaxes, since for the other series of results the values of $S$ and $S'$ are very nearly the same. A direct comparison between parallaxes of the same stars measured at the four observatories shows that the correction to the McCormick parallaxes seemingly depends upon the apparent magnitude, so that the unweighted mean probably gives a more reliable value for the systematic correction for these stars in general.

### THE CEPHEIDS AND PSEUDO-CEPHEIDS

The absolute magnitudes of the Cepheid variables and the stars with similar spectra, which for convenience we may call Pseudo-Cepheids, have been computed from the parallactic motions alone, the trigonometric parallaxes being too small to furnish reliable data for this purpose. These two classes of stars have been reduced with the same tables, as it was found that their mean absolute magnitudes were about the same.

If the absolute magnitudes of the Cepheids are plotted against $0.2m+\log \mu$, a marked correlation between these quantities can be found.

### TAURUS GROUP

A comparison of the spectroscopic parallaxes of the stars belonging to the Taurus group with the parallaxes of these stars as measured by Boss[1] and Kapteyn[2] was made and the results are given in the following table:

TABLE V

| Spectrum | $M$ | Number* | $\pi'$ | $\pi_0$ | $\Delta M$ |
|---|---|---|---|---|---|
| A8–F2..... | 1.6 to 2.5 | 7 | 0".017 | 0".025 | +0".86 |
| F5–G0..... | 3.7 to 4.1 | 7 | .020 | .024 | +0.45 |
| G5–K2..... | 4.5 to 5.5 | 4 | .022 | .023 | +0.12 |
| G7–G9..... | 0.4 to 1.4 | 4 | .025 | .025 | −0.03 |

* Several of the stars used here are not given in the main table, as in some cases only one spectrogram has been secured.

The large positive correction to the absolute magnitudes for the F-type stars cannot be reconciled with the great number of large trigonometric parallaxes for the stars of this type in general. Most of the F-type stars belonging to the Taurus group, however, show very hazy lines which are difficult of estimation, and for this reason these stars can probably not be regarded as representative of the F stars in general.

[1] *Astronomical Journal*, No. 604, 1908.

[2] *Groningen Publications*, No. 23, 1909.

COMPARISON WITH RESULTS FOR FIVE HUNDRED STARS

The absolute magnitudes of the stars contained in the list of 500 published in 1917[1] were subject to errors due mainly to three causes: (1) the insufficiency of the trigonometric parallax material upon which the reduction curves were based; (2) the resulting necessity for grouping into too large divisions of spectral type; (3) the uncertainty in the reduction of the Cepheid variables.

The discussion of the method of reduction used for the stars contained in this list shows how great an improvement has been effected as regards the first two of these factors. A completely different system of reduction has been used for the Cepheid variables and stars having a similar type of spectrum. These were treated under the normal spectral types in the list of 500 stars, while in the present discussion they have been reduced independently as a special class. This has resulted in a large systematic difference compared with the earlier values, the present absolute magnitudes being considerably brighter.

TABLE VI

DIFFERENCES IN *M*, 1920 SYSTEM *minus* 500 STARS

| | $M<3.0$ | | $M=3.0-5.0$ | | $M>5.0$ | |
|---|---|---|---|---|---|---|
| | Number | Difference | Number | Difference | Number | Difference |
| A–F8.... | 23 | −0.46 | 77 | −0.54 | 1 | −0.3 |
| F9–G8... | 51 | −0.30 | 51 | −0.05 | 41 | −0.20 |
| G9–K4... | 78 | +0.08 | 12 | +0.83 | 64 | −0.12 |
| K5–K9... | 10 | −1.01 | ..... | ..... | 29 | −0.07 |
| M..... | 29 | −1.12 | ..... | ..... | 15 | −0.10 |
| Cepheids. | 14 | −2.9 | ..... | ..... | ..... | ..... |
| All types except Cepheids | 191 | −0.32 | 140 | −0.24 | 150 | −0.13 |

The summary above gives the results of a comparison for 495 stars common to the two lists, the differences given being the corrections necessary to apply to the stars in the list of 500 in order to reduce their absolute magnitudes to the present system. As would be expected, the corrections for the fainter stars are considerably smaller than those for the brighter.

[1] *Mt. Wilson Contr.*, No. 142; *Astrophysical Journal*, **46**, 313, 1917.

METHOD OF ESTIMATION OF INTENSITIES

A brief description of the method of classifying the spectra and of estimating the intensities of the spectral lines used in the determination of the absolute magnitudes will perhaps be of value.

The spectrograms are examined under a Hartmann spectrocomparator and the hydrogen lines are first compared with the neighboring lines λλ 4326, 4352, and 4405 in the case of Hγ, and λλ 4872 and 4957 in the case of Hβ. From the relative intensities of these pairs of lines, with the aid of a reduction table based upon standard spectra, the "measured" type of spectrum is determined. In the case of spectra between Fo and Go comparisons are also made with λλ 4227 and 4384, while Hβ is omitted.

Estimations of the spectral type are made from direct comparisons with typical spectra selected from the Harvard list. The spectra of three stars having the types Fo, F5, and Go have been photographed upon one standard plate, and those of three other stars with spectra G5, Ko, and K5 upon another plate. These spectra are placed under the second microscope of the spectrocomparator and are brought side by side with that of the star to be classified. Values intermediate between those of the typical stars are estimated from comparison with the stars having spectra on either side, especial consideration being given to the calcium line λ 4227 and the chromium lines λλ 4255 and 4275, which vary rapidly with spectral type and form a valuable criterion. It is probable that all three of these lines vary to some extent with absolute magnitude, but the effect seems to be slight except in extreme cases like the Cepheid variables.

The estimations of the relative intensities of the pairs of lines for determinations of absolute magnitude are made in the same way as those of the hydrogen lines. In stars of types A to F7 the lines compared are $\frac{4}{4}\frac{0}{0}\frac{7}{7}\frac{7}{2}$ and $\frac{4}{4}\frac{2}{2}\frac{9}{7}\frac{0}{1}$. In types F8 to G, the three pairs $\frac{4}{4}\frac{2}{2}\frac{1}{5}\frac{5}{0}$, $\frac{4}{4}\frac{4}{4}\frac{5}{6}\frac{5}{2}$, and $\frac{4}{4}\frac{4}{4}\frac{5}{9}\frac{5}{5}$ have been added, and these have been used exclusively for later types of spectra except the M-type giants. The latter and the Cepheid variables have been treated separately. For the M-type giants the intensities of the lines λλ 4077 and 4215 have been compared directly with those in the spectra of the stars

$\beta$ Andromedae and $\mu$ Geminorum. In the case of the Cepheids the pairs of lines have been $\frac{4\,0\,7\,7}{4\,0\,7\,2}$, $\frac{4\,2\,1\,5}{4\,2\,5\,0}$, and $\frac{4\,2\,9\,0}{4\,2\,7\,1}$, a special table being used for reduction purposes.

## DESCRIPTION OF CATALOGUE

In the extensive table which follows, the successive columns contain the following data for each star:

Column 1. Number in Boss *P.G.C.* or in *Cincinnati Publication*, No. 18.

2. Name of star, double stars being assigned the number in Burnham's *General Catalogue* in case they have no Greek letter or Flamsteed number.

3 and 4. Right ascension and declination for 1900.

5. The magnitudes from the revised *Draper Catalogue* are used for stars within the first twelve hours of right ascension. In the case of faint B.D. stars the B.D. magnitude has been corrected in accordance with the values given in *H.A.*, **72**, 214. In the case of double stars and spectroscopic binaries, the magnitude of the brighter component has been calculated from the combined magnitude in accordance with the relative intensities of the two components.

6. Total proper motion taken from Boss's *P.G.C.* or *Cin.* 18 when given.

7. Estimated Mount Wilson spectrum.

8. Spectrum as determined from the intensities of the hydrogen lines.

9. Absolute magnitude $M'$ calculated from the line-intensities.

10. Parallax corresponding to $M'$.

11. Weighted trigonometric parallax.

12. Authority for the trigonometric parallax. The following are the principal abbreviations used: A, Allegheny; Ab, Abetti; C, Cape; D, Dearborn; F, Flint; G, Greenwich; J, Jewdokimow; Jo, Jost; K, Kapteyn; Kos, Kostinsky; M, McCormick; R, Russell; Ram, Rambaut; S, Sproul; W, Mount Wilson; Y, Yale; Ye, Yerkes.

The significance of the symbols occurring in the catalogue is as follows:

* See note at end of table.

† Magnitude corrected to the brighter component of the double star or spectroscopic binary.

‡ Unpublished proper motion by Kapteyn.

§ Cepheid or Pseudo-Cepheid reduced by special curves.

‖ Unpublished proper motion by Roy.

TABLE VII

| Boss | Name | α 1900 | δ 1900 | Harv. Vis. Mag. | μ | Spectrum | | Spect. Abs. Mag. | Spect. π | Trig. π | Auth. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Est. | Meas. | | | | |
| C 2 | Bu. 12740 S. | $0^h\ 0^m.4$ | +45°16′ | 8.9 | 0″.858 | K7 | ..... | 8.8 | 0″.096 | 0″.102 | A, Ye, Y, D |
| 3 | Bu. 12755 Br. | 0 1.0 | +57 53 | 6.4 | 0.266 | G4 | G2 | 5.3 | 0.060 | 0.036 | S |
| 3 | Bu. 12755 Ft. | 0 1.0 | +57 53 | 7.5 | 0.266 | G7 | G7 | 5.3 | 0.036 | | |
| 6 | ..... | 0 1.4 | +28 28 | 6.2 | 0.419 | G9 | G7 | 5.8 | 0.083 | 0.150 | Y |
| 9 | 5 Ceti | 0 3.1 | − 3 0 | 6.3 | 0.006 | K2 | G4 | 1.2 | 0.010 | | |
| 12 | β Cassiop | 0 3.8 | +58 36 | 2.4 | 0.559 | F2 | F4 | 1.6 | 0.069 | 0.071 | A, M, Y, *et al.* |
| C 9 | A.G. Hels. 38 | 0 4.0 | +64 31 | 7.0 | 0.30 | Ko | G9 | 4.3 | 0.029 | | |
| 19 | 22 Androm | 0 5.1 | +45 31 | 5.1 | 0.004 | F2 | F3 | 1.3 | 0.017 | | |
| ..... | A.G. Chris. 15 | 0 5.4 | +66 35 | 9.2 | 0.138‡ | G8 | G7 | 4.1 | 0.010 | | |
| ..... | A.G. Leiden 33 | 0 5.4 | +32 34 | 7.2 | 0.052‡ | K5 | Ko | 0.5 | 0.005 | | |
| ..... | SX Cassiop.* | 0 5.5 | +54 20 | 9.1† | ..... | A6p | ..... | 2.2 | 0.004 | | |
| 31 | χ Pegasi | 0 9.4 | +19 39 | 4.9 | 0.094 | Ma | K2 | 0.0 | 0.010 | 0.015 | A |
| 33 | 7 Ceti | 0 9.6 | −19 29 | 4.7 | 0.068 | Ma | K2 | 1.1 | 0.019 | | |
| 41 | ..... | 0 11.6 | +60 59 | 5.8 | 0.002 | G3 | G2 | − 0.9 | 0.004 | | |
| C 25 | Groom. 34 | 0 12.7 | +43 27 | 8.1 | 2.890 | Ma | ..... | 10.4 | 0.288 | 0.280 | Ye, Y, R, *et al.* |
| 53 | ι Ceti | 0 14.3 | − 9 23 | 3.8 | 0.037 | K3 | K1 | 0.6 | 0.023 | | |
| 56 | 41 Piscium | 0 15.5 | + 7 38 | 5.6 | 0.015 | K3 | Ko | 0.7 | 0.010 | | |
| 62 | 42 Piscium | 0 17.2 | +12 56 | 6.4 | 0.063 | K2 | K1 | 0.9 | 0.008 | | |
| 63 | 9 Ceti | 0 17.7 | −12 46 | 6.4 | 0.396 | G2 | G2 | 5.7 | 0.072 | | |
| ..... | A.G. Leiden 117 | 0 20.3 | +33 34 | 8.3 | 0.019‡ | Ko | G8 | 1.7 | 0.005 | | |
| ..... | A.G. Leiden 134 | 0 22.3 | +33 29 | 8.0 | 0.075‡ | Ko | G7 | 3.3 | 0.012 | | |
| 81 | 47 Piscium | 0 22.8 | +17 20 | 5.3 | 0.117 | Mb | G6 | 0.1 | 0.009 | | |
| 84 | 48 Piscium | 0 23.0 | +15 54 | 6.5 | 0.018 | K5 | K1 | 0.5 | 0.006 | | |
| 86 | ..... | 0 24.5 | +76 28 | 6.4 | 0.335 | Ko | G9 | 3.9 | 0.032 | | |
| 89 | 28 Androm | 0 24.8 | +29 12 | 5.3 | 0.066 | F2 | F3 | 2.5 | 0.028 | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 90 | 12 Ceti | $0^h24^m9$ | $-4°31'$ | 6.0 | 0".011 | K4 | K2 | 0.7 | 0".008 | | |
| 96 | | 0 26.2 | +52 17 | 5.7 | 0.056 | Ko | G9 | 0.3 | 0.008 | 0".008 | W |
| 106 | | 0 27.5 | +27 44 | 6.4 | 0.014 | G6 | G6 | − 0.2 | 0.005 | 0.005 | W |
| 116 | 13 Ceti | 0 30.1 | − 4 9 | 5.7† | 0.408 | F7 | F8 | 3.8 | 0.042 | 0.053 | S |
| 121 | | 0 31.3 | +43 56 | 5.4 | 0.035 | K2 | G8 | 1.4 | 0.016 | | |
| 125 | | 0 32.0 | +34 51 | 5.6 | 0.019 | Go | F7 | − 0.3 | 0.007 | | |
| 127 | Bu. 335 | 0 32.2 | −25 19 | 6.4† | 1.390 | G9 | G5 | 5.5 | 0.066 | 0.104 | M, F |
| 128 | | 0 32.4 | + 2 35 | 6.6 | 0.122 | K3 | Ko | 1.1 | 0.008 | | |
| 130 | $\epsilon$ Androm. | 0 33.3 | +28 46 | 4.5 | 0.336 | G3 | G3 | 0.2 | 0.014 | 0.063 | A, Ye, S |
| 131 | | 0 33.6 | +48 48 | 5.7 | 0.019 | K5 | G9 | 0.5 | 0.009 | | |
| C 80 | Lal. 999 | 0 34.0 | + 2 35 | 7.4 | 0.819 | G4 | G1 | 5.5 | 0.042 | 0.033 | Y, J |
| 132 | $\delta$ Androm. | 0 34.0 | +30 19 | 3.5 | 0.162 | K3 | K3 | 0.8 | 0.029 | 0.020 | A |
| 133 | 54 Piscium | 0 34.2 | +20 43 | 6.1 | 0.595 | K1 | Ko | 6.2 | 0.105 | 0.111 | A, M, Y |
| 135 | $\alpha$ Cassiop. | 0 34.8 | +55 59 | 2.5 | 0.060 | G8 | G8 | − 1.0 | 0.020 | 0.023 | M, F |
| C 86 | Lal. 1045 | 0 35.3 | +39 39 | 7.5 | 0.797 | K4 | K2 | 6.3 | 0.058 | 0.054 | A, Y |
| C 87 | Lal. 1065 | 0 35.5 | −24 21 | 6.2 | 0.711 | G2 | G3 | 4.7 | 0.050 | | |
| 137 | | 0 35.6 | − 4 54 | 6.1 | 0.023 | G8 | G6 | 1.5 | 0.012 | | |
| 138 | 32 Androm. | 0 35.7 | +38 55 | 5.4 | 0.007 | G6 | G5 | 1.1 | 0.013 | | |
| | Groom. 127 | 0 37.8 | +70 17 | 6.9 | 0.035 | G7 | G5 | 1.4 | 0.008 | | |
| 147 | $\beta$ Ceti | 0 38.6 | −18 32 | 2.2 | 0.230 | G6 | G6 | 0.3 | 0.042 | −0.052 | F |
| C 98 | Lal. 1198 | 0 40.0 | + 1 15 | 8.1 | 0.591 | K5 | K6 | 6.7 | 0.052 | 0.056 | M, Y |
| 160 | | 0 41.2 | −23 4 | 5.6 | 0.189 | G7 | G6 | 2.5 | 0.024 | | |
| 161 | 57 Piscium | 0 41.3 | +14 56 | 5.6 | 0.064 | Mb | G8 | 0.4 | 0.009 | 0.014 | W |
| 164 | $\zeta$ Androm. | 0 42.0 | +23 43 | 4.3 | 0.129 | G7 | G4 | 0.8 | 0.020 | 0.031 | A |
| 165 | 60 Piscium | 0 42.2 | + 6 12 | 6.2 | 0.016 | G8 | G5 | 1.4 | 0.011 | | |
| 168 | $\eta$ Cassiop. Br. | 0 43.0 | +57 17 | 3.7 | 1.242 | F8 | Go | 4.3 | 0.132 | 0.186 | A, M, S, *et al.* |
| 168 | $\eta$ Cassiop. Ft. | 0 43.0 | +57 17 | 7.4 | 1.242 | K5 | K2 | 8.3 | 0.151 | | |
| 171 | | 0 43.1 | + 4 46 | 5.8 | 1.366 | K3 | K1 | 6.5 | 0.138 | 0.170 | Y, F |
| C105 | Groom 145 | 0 43.3 | +69 54 | 8.0 | 0.415 | K3 | K2 | 6.2 | 0.044 | 0.028 | Y |
| 173 | $\delta$ Piscium | 0 43.5 | + 7 2 | 4.6 | 0.093 | K5 | K1 | 0.9 | 0.018 | 0.017 | A |

TABLE VII—*Continued*

| Boss | Name | α 1900 | δ 1900 | Harv. Vis. Mag. | μ | Spectrum | | Spect. Abs. Mag. | Spect. π | Trig. π | Auth. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Est. | Meas. | | | | |
| 174 | 64 Piscium | $0^h43^m.7$ | +16°24′ | 5.2 | 0″.204 | F4 | F7 | 3.5 | 0″.046 | | |
| 178¹ | 65¹ Piscium | 0 44.5 | +27 10 | 6.3 | 0.092 | Fo | F2 | 0.7 | 0.008 | 0″.010 | W |
| 178² | 65² Piscium | 0 44.5 | +27 10 | 6.3 | 0.092 | Fo | F1 | 1.4 | 0.011 | | |
| 181 | 19 Ceti | 0 45.1 | −11 11 | 5.2 | 0.325 | F8 | F7 | 3.9 | 0.055 | | |
| 189 | | 0 47.1 | +60 35 | 4.9 | 0.188 | F8 | F7 | 3.6 | 0.055 | | |
| 191 | 20 Ceti | 0 47.9 | − 1 41 | 4.9 | 0.017 | K6 | Ko | 0.3 | 0.012 | | |
| 193 | 26 Cassiop. | 0 49.1 | +58 26 | 5.0 | 0.053 | K2 | K1 | 0.5 | 0.013 | | |
| 200 | 28 Cassiop | 0 50.7 | +58 38 | 4.8 | 0.100 | G5 | G6 | 0.7 | 0.015 | 0.073 | A |
| 206 | η Androm. | 0 51.9 | +22 53 | 5.0† | 0.060 | G6 | G8 | 0.5 | 0.013 | 0.011 | A |
| 209 | 68 Piscium | 0 52.4 | +28 27 | 5.6 | 0.017 | G7 | G6 | 0.0: | 0.008 | | |
| 210 | | 0 52.7 | +13 9 | 6.4 | 0.022 | G5 | G4 | 0.1 | 0.005 | | |
| 217 | | 0 54.6 | + 5 57 | 6.3 | 0.023 | Mb | G6 | 1.0 | 0.009 | −0.001 | W |
| 218 | 2 Urs. Min. | 0 55.0 | +85 43 | 4.5 | 0.086 | K3 | K2 | 0.5 | 0.016 | | |
| C136 | Lal. 1799 | 0 57.2 | + 4 31 | 8.4 | 0.438 | K5 | K4 | 7.1 | 0.055 | 0.038 | M, Y |
| 226 | ε Piscium | 0 57.8 | + 7 21 | 4.4 | 0.085 | G6 | G6 | 0.2 | 0.014 | 0.027 | A, M |
| 233 | 73 Piscium | 0 59.7 | + 5 7 | 6.2 | 0.031 | K4 | Ko | 0.8 | 0.008 | | |
| C142 | A.G. Hels. 914 | 1 0.3 | +63 24 | 8.7 | 1.55 | K7 | K4 | 8.4 | 0.087 | | |
| 243 | 75 Piscium | 1 1.3 | +12 25 | 6.2 | 0.040 | G7 | G6 | 1.8 | 0.013 | | |
| 244 | μ Cassiop. | 1 1.6 | +54 26 | 5.3 | 3.760 | G5 | G3 | 5.6 | 0.115 | 0.127 | A, Ye, F, *et al.* |
| C146 | Lal. 1964 | 1 2.2 | +22 26 | 8.6 | 0.525 | K5 | K4 | 7.5 | 0.060 | 0.097 | Y |
| 252 | 80 Piscium | 1 3.2 | + 5 7 | 5.7 | 0.326 | F1 | F1 | 2.5 | 0.023 | | |
| C149 | Lal. 1966 | 1 3.3 | +61 1 | 7.8 | 0.638 | F5 | F5 | 3.5 | 0.014 | 0.022 | Ye, Y |
| 255 | η Ceti | 1 3.6 | −10 43 | 3.6 | 0.246 | K2 | K1 | 1.2 | 0.033 | | |
| 259 | β Androm. | 1 4.1 | +35 5 | 2.4 | 0.216 | Ma. | G8 | 0.5 | 0.042 | 0.049 | A, M, F |
| C150 | Lal. 1985 | 1 4.1 | +67 15 | 6.6 | 0.236 | F7 | F8 | 4.0 | 0.030 | 0.023 | G |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 261 | 81 Piscium | 1h 4m5 | +19° 7′ | 5.6 | 0″.004 | F2 | F5 | 0.4 | 0″.009 | | |
| 267 | 33 Ceti | 1 5.4 | + 1 55 | 6.2 | 0.004 | K4 | Ko | 0.7 | 0.008 | | |
| 270 | χ Piscium | 1 6.1 | +20 30 | 4.9 | 0.021 | G5 | G6 | 0.0 | 0.010 | 0″.013 | A |
| 271 | τ Piscium | 1 6.2 | +29 34 | 4.7 | 0.081 | K1 | G9 | 0.5 | 0.014 | | |
| 281 | φ Piscium | 1 8.3 | +24 3 | 4.6 | 0.047 | G7 | G7 | 0.4 | 0.014 | | |
| 287 | 38 Ceti | 1 9.7 | − 1 31 | 5.8 | 0.221 | F4 | F6 | 2.8 | 0.025 | | |
| C165 | W.B. 1h161 | 1 13.5 | − 1 23 | 8.1 | 0.489 | K1 | G8 | 6.1 | 0.040 | −0.011 | Y |
| C167 | Lal. 2387 | 1 14.0 | − 9 27 | 8.9 | 0.528 | G1 | Go | 4.7 | 0.014 | 0.026 | Y |
| C174 | W.B. 1h262 | 1 15.8 | +30 49 | 8.8 | 0.50 | K2 | K2 | 6.3 | 0.032 | | |
| 304 | ξ Androm. | 1 16.4 | +45 0 | 5.0 | 0.41 | Ko | G9 | 1.0 | 0.016 | | |
| C177 | Lal. 2450 | 1 16.9 | +18 10 | 8.0 | 0.524 | G1 | G1 | 4.7 | 0.022 | 0.017 | Y |
| 305 | 43 Ceti | 1 17.5 | − 0 58 | 6.5 | 0.017 | Ko | G9 | 0.5 | 0.006 | | |
| 310 | ψ Cassiop | 1 18.9 | +67 36 | 5.0 | 0.086 | K1 | G9 | 0.8 | 0.014 | | |
| 313 | θ Ceti | 1 19.0 | − 8 42 | 3.8 | 0.228 | Ko | G9 | 0.3 | 0.020 | 0.101 | F |
| C185 | W.B. 1h356 | 1 19.5 | +17 59 | 9.1 | 0.606 | K2 | K1 | 6.3 | 0.028 | | |
| 318 | ρ Piscium | 1 20.9 | +18 39 | 5.3 | 0.041 | Fo | F1 | 2.7 | 0.030 | | |
| 321 | ω Androm. | 1 21.7 | +44 53 | 5.0 | 0.356 | F1 | F6 | 2.6 | 0.033 | 0.022 | M, Ye, F, J |
| 325 | α Urs. Min. § | 1 22.6 | +88 46 | 2.1 | 0.044 | F9 | F8 | − 3.0 | 0.010 | 0.041 | F *et al.* |
| C196 | Lal. 2682 | 1 23.6 | +21 13 | 7.9 | 0.495 | K3 | K2 | 6.4 | 0.050 | 0.067 | Y, D |
| 327 | 38 Cassiop | 1 23.8 | +69 45 | 6.0 | 0.158 | F4 | F6 | 3.7 | 0.035 | 0.039 | A |
| 332 | μ Piscium | 1 24.9 | + 5 38 | 5.1 | 0.292 | K5 | K1 | 0.5 | 0.012 | | |
| 335 | η Piscium | 1 26.1 | +14 50 | 3.7 | 0.031 | G5 | G6 | − 0.4 | 0.015 | 0.022 | A, M |
| C204 | Lal. 2751 | 1 27.3 | +68 26 | 6.7 | 0.402 | G3 | G2 | 4.7 | 0.040 | 0.026 | G |
| 338 | χ Cassiop | 1 27.4 | +58 43 | 4.9 | 0.038 | G5 | G7 | −0.1 | 0.010 | 0.020 | A |
| ..... | Groom. 331 | 1 27.7 | +71 56 | 7.8 | 0.037 | F6 | F9 | 1.5 | 0.006 | | |
| 349 | 40 Cassiop | 1 30.5 | +72 32 | 5.5 | 0.008 | G5 | G5 | −0.3 | 0.007 | | |
| 350 | υ Androm. | 1 30.9 | +40 54 | 4.2 | 0.418 | F8 | F9 | 3.7 | 0.079 | 0.057 | M |
| 355 | ..... | 1 31.6 | +57 28 | 5.7 | 0.004 | Ko | G6 | −0.3 | 0.006 | | |
| 357 | υ Persei | 1 31.9 | +48 7 | 3.8 | 0.127 | K4 | K1 | 0.5 | 0.022 | 0.034 | A |
| C226 | Lal. 2975 | 1 32.7 | +29 4 | 8.7 | 0.482 | K1 | G9 | 6.1 | 0.030 | | |

TABLE VII—*Continued*

| Boss | Name | α 1900 | δ 1900 | Harv. Vis. Mag. | μ | Spectrum | | Spect. Abs. Mag. | Spect. π | Trig. π | Auth. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Est. | Meas. | | | | |
| C229 | Lal. 3022 | $1^h33^m9$ | +27°36′ | 7.9 | 0″.502 | G8 | G5 | 5.4 | 0″.032 | 0″.047 | Y |
| C231 | Lal. 2966 | 1 34.2 | +66 25 | 7.6 | 0.753 | G4 | G1 | 5.9 | 0.046 | 0.036 | Y |
| 372 | | 1 35.7 | +42 7 | 5.1 | 0.817 | G1 | G0 | 4.8 | 0.087 | 0.098 | A, M, Y, J |
| 373 | | 1 35.7 | +25 14 | 6.3 | 0.135 | F3p | F4 | 2.6 | 0.018 | 0.036 | W |
| 375 | | 1 36.0 | +29 32 | 6.0 | 0.013 | G7 | G7 | 0.6 | 0.008 | | |
| 378 | ν Piscium | 1 36.2 | + 4 59 | 4.7 | 0.021 | K4 | K1 | 0.8 | 0.017 | 0.055 | A |
| C238 | A.Oe. 1867 | 1 36.8 | +63 20 | 8.2 | 0.70 | K5 | K5 | 7.7 | 0.079 | | |
| 381 | Bu. 877 Br | 1 36.8 | −11 49 | 6.1† | 0.410 | F2 | F4 | 2.7 | 0.021 | | |
| 382 | 107 Piscium | 1 37.1 | +19 47 | 5.3 | 0.734 | K1 | K1 | 5.8 | 0.126 | 0.129 | Y |
| C240 | Lal. 3153 | 1 37.4 | −18 24 | 7.4 | 0.543 | G0 | G1 | 4.7 | 0.029 | | |
| 387 | | 1 37.7 | − 4 12 | 5.3 | 0.028 | K3 | K1 | 0.5 | 0.011 | | |
| 391 | τ Ceti | 1 39.4 | −16 28 | 3.6 | 1.922 | G7 | G5 | 6.1 | 0.316 | 0.317 | M, F, Sitt |
| 393 | o Piscium | 1 40.1 | + 8 39 | 4.5 | 0.085 | G6 | G7 | 0.0 | 0.012 | 0.017 | A |
| 394 | | 1 40.5 | +63 22 | 5.7 | 0.634 | K0 | G9 | 5.6 | 0.096 | 0.089 | Y, J |
| 405 | | 1 43.0 | +32 11 | 5.8 | 0.354 | F7 | F7 | 3.8 | 0.040 | | |
| 410 | 1 Arietis Br | 1 44.6 | +21 47 | 6.2† | 0.018 | G9 | K0 | 1.2 | 0.010 | | |
| 414 | 54 Ceti | 1 45.6 | +10 33 | 5.9 | 0.074 | F3 | ..... | 2.7 | 0.023 | | |
| 420 | 55 Androm | 1 47.3 | +40 14 | 5.6 | 0.009 | K2 | K0 | 0.5 | 0.010 | 0.006 | W |
| 421 | α Trianguli | 1 47.4 | +29 6 | 3.6 | 0.233 | F2 | F4 | 1.2 | 0.033 | 0.050 | A |
| 426 | ξ Piscium | 1 48.4 | + 2 42 | 4.8 | 0.033 | G7 | G5 | 0.7 | 0.015 | | |
| 430 | | 1 50.0 | +36 47 | 6.1 | 0.005 | K3 | G9p | 1.0 | 0.009 | | |
| 432 | 56 Androm | 1 50.2 | +36 46 | 5.8 | 0.180 | G9 | G7 | 1.7 | 0.015 | | |
| 434 | 7 Arietis | 1 50.3 | +23 5 | 6.0 | 0.011 | K0 | G8 | 0.9 | 0.010 | | |
| ..... | B.D. +32°356 | 1 52.3 | +32 28 | 8.8 | ..... | F8 | F7 | 2.6 | 0.006 | −0.001 | D |
| ..... | A.G. Leiden 743 | 1 53.1 | +33 51 | 7.6 | 0.033‡ | G9 | G6 | 1.9 | 0.008 | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 450 | 112 Piscium | $1^h54^m.9$ | $+2°37'$ | 5.8 | 0″.336 | Go | F9 | 4.0 | 0″.044 | | |
| 451 | 47 Cassiop | 1 55.1 | −21 19 | 5.7 | 0.014 | Ma | G8 | 0.3 | 0.008 | | |
| 453 | $\upsilon$ Ceti | 1 55.3 | −21 34 | 4.2 | 0.130 | K6 | K3 | 0.7 | 0.020 | | |
| | Groom. 441 | 1 56.8 | +54 13 | 7.7 | 0.026 | F6 | F6 | 3.0 | 0.012 | | |
| 468 | $\gamma^1$ Androm | 1 57.8 | +41 51 | 2.3 | 0.070 | K2 | G9 | −0.1 | 0.033 | 0″.010 | A, S, Y, F |
| 472 | | 1 58.2 | +17 46 | 6.4 | 0.024 | K4 | K1 | 0.9 | 0.008 | | |
| 477 | $\alpha$ Arietis | 2 1.5 | +22 59 | 2.2 | 0.239 | K2 | Ko | 0.7 | 0.050 | 0.044 | A, F, J |
| C274 | Lal. 3922 | 2 2.5 | − 1 5 | 6.9 | 0.466 | G1 | Go | 4.1 | 0.028 | −0.042 | Y |
| 486 | | 2 4.1 | +73 33 | 6.2 | 0.071 | G6 | G5 | −0.2 | 0.005 | | |
| 493 | 16 Arietis | 2 5.5 | +25 28 | 6.2 | 0.011 | K4 | K2 | 0.9 | 0.008 | | |
| 498 | 55 Cassiop | 2 6.6 | +66 3 | 6.2 | 0.003 | F6 | F7 | 3.2 | 0.025 | | |
| 500 | 6 Persei | 2 7.0 | +50 36 | 5.4 | 0.386 | G5 | G5 | 0.7 | 0.012 | 0.006 | A, Ye |
| C286 | Lal. 3987 | 2 7.5 | +67 13 | 7.8 | 0.603 | K2 | K2 | 6.1 | 0.046 | ▫.071 | S, Y |
| | Bu. 1144 | 2 7.6 | +47 1 | 6.4 | 0.112‡ | F1 | F4 | 3.4 | 0.025 | 0.075 | S |
| 504 | $66^2$ Ceti | 2 7.7 | − 2 52 | 5.7 | 0.374 | F9 | F8 | 3.3 | 0.033 | | |
| 505 | 65 Ceti | 2 7.7 | + 8 23 | 4.5 | 0.026 | G4 | G3 | −1.4 | 0.006 | | |
| C288 | A.Oe. 2526 | 2 9.2 | +64 30 | 8.4 | 0.50 | G2 | G2 | 5.8 | 0.030 | | |
| C289 | W.B. $2^h95$ | 2 9.5 | − 1 40 | 9.2 | 1.034 | F8 | F8 | 3.9 | 0.009 | 0.014 | Y |
| C291 | Lal. 4141 | 2 9.7 | +23 49 | 6.9 | 0.494 | G7 | G4 | 4.7 | 0.036 | 0.036 | M, Y |
| 513 | 8 Persei | 2 10.9 | +57 26 | 6.1 | 0.073 | K2 | K1 | 0.7 | 0.008 | | |
| 514 | $\delta$ Trianguli | 2 10.9 | +33 46 | 5.1 | 1.182 | Go | Go | 4.8 | 0.087 | 0.101 | A, M, Y, *et al.* |
| 515 | 7 Persei | 2 11.0 | +57 3 | 6.2 | 0.007 | G4 | G3 | −0.3 | 0.005 | | |
| | Groom. 489 | 2 11.4 | +42 8 | 7.9 | 0.022 | F1 | F3 | 2.3 | 0.008 | | |
| 518 | 67 Ceti | 2 12.0 | − 6 53 | 5.7 | 0.141 | G8 | G7 | 0.9 | 0.011 | | |
| 523 | | 2 12.8 | + 1 17 | 5.8 | 0.527 | F7 | F8 | 3.6 | 0.036 | 0.024 | M |
| C298 | A.Oe. 2618 | 2 14.0 | +70 43 | 8.5 | 0.62 | K2 | K1 | 6.3 | 0.036 | | |
| 532 | | 2 14.5 | −26 25 | 6.4 | 0.505 | G7 | G6 | 5.0 | 0.052 | | |
| C300 | Lal. 4222 | 2 14.5 | +68 18 | 7.4 | 0.13 | Ko | Go | 2.8 | 0.012 | | |
| 539 | 69 Ceti | 2 16.8 | − 0 4 | 5.9 | 0.006 | Ma | G7 | 0.2 | 0.007 | | |
| | A.G. Leiden 886 | 2 17.9 | +33 24 | 7.6 | 0.056‡ | K3 | K1 | 0.9 | 0.005 | | |

TABLE VII—*Continued*

| Boss | Name | α 1900 | δ 1900 | Harv. Vis. Mag. | μ | Spectrum | | Spect. Abs. Mag. | Spect. π | Trig. π | Auth. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Est. | Meas. | | | | |
| 543 | κ Fornacis | $2^h18^m.0$ | −24° 16′ | 5.4 | 0″.210 | G2 | G1 | 2.4 | 0″.025 | | |
| 545 | 65 Androm. | 2 19.0 | +49 50 | 4.9 | 0.031 | K5 | K1 | 0.3 | 0.012 | 0″.005 | A |
| 556 | 25 Arietis | 2 22.1 | + 9 45 | 6.5 | 0.355 | F5 | F6 | 3.8 | 0.029 | | |
| 572 | | 2 26.3 | + 1 49 | 5.4 | 0.013 | K3 | G9 | 1.0 | 0.013 | | |
| 575 | σ Ceti | 2 27.3 | −15 41 | 4.8 | 0.141 | F1 | F3 | 2.2 | 0.030 | | |
| 577 | 36 H Cassiop. | 2 28.5 | +72 23 | 5.3 | 0.031 | G4 | G5 | −0.6 | 0.007 | | |
| 581 | | 2 29.5 | +36 52 | 5.9 | 0.010 | K3 | G9 | 0.9 | 0.010 | | |
| 582 | 15 Trianguli | 2 29.7 | +34 15 | 5.6 | 0.061 | Ma | G7 | 0.3 | 0.009 | 0.015 | W |
| 588 | | 2 30.6 | + 6 25 | 5.9 | 2.320 | K3 | K4 | 6.5 | 0.132 | 0.131 | A, M, Y, *et al.* |
| 589 | ν Ceti | 2 30.6 | + 5 9 | 5.0 | 0.042 | G3 | G4 | −0.7 | 0.008 | | |
| 591 | 31 Arietis | 2 31.2 | +12 1 | 5.7 | 0.297 | F4 | F6 | 3.9 | 0.044 | | |
| 592 | $30^1$ Arietis | 2 31.2 | +24 13 | 7.4 | 0.152 | F5 | F6 | 3.1 | 0.014 | 0.029 | W, S |
| 593 | $30^2$ Arietis | 2 31.2 | +24 13 | 6.6 | 0.140 | F3 | F4 | 2.9 | 0.018 | | |
| C340 | Lal. 4855 | 2 32.6 | +30 24 | 7.2 | 0.625 | Go | F8 | 4.4 | 0.028 | 0.026 | Y, F |
| 605 | ε Ceti | 2 34.7 | −12 18 | 5.0 | 0.280 | F4 | F4 | 2.7 | 0.035 | | |
| 612 | 84 Ceti | 2 36.1 | − 1 7 | 5.7 | 0.250 | F6 | F7 | 3.5 | 0.036 | | |
| 617 | θ Persei | 2 37.4 | +48 48 | 4.2 | 0.351 | F6 | F6 | 3.9 | 0.087 | 0.083 | A, Y |
| 619 | 14 Persei § | 2 37.6 | +43 52 | 5.6 | 0.004 | Gop | F7 | −2.6 | 0.003 | | |
| 622 | γ Ceti Ft. | 2 38.1 | + 2 49 | 6.2 | 0.210 | F3 | F6 | 4.1 | 0.038 | 0.049 | A, M, Ye, Y |
| 631 | 1 Eridani | 2 40.4 | −19 0 | 4.6 | 0.327 | F7 | F6 | 3.6 | 0.063 | | |
| 634 | 39 Arietis | 2 42.0 | +28 50 | 4.6 | 0.196 | K1 | G9 | 0.0 | 0.012 | 0.027 | A |
| 637 | SU Cassiop. § | 2 43.0 | +68 28 | 6.1 | 0.016 | F4 | F4 | −1.4 | 0.003 | 0.010 | W |
| 639 | η Persei | 2 43.4 | +55 29 | 3.9 | 0.030 | K4 | G5 | 0.4 | 0.020 | | |
| 644 | 16 Persei | 2 44.3 | +37 54 | 4.3 | 0.213 | A8 | Fo: | 1.5 | 0.028 | 0.022 | A |
| C364 | A.G. Bonn 2435 | 2 44.9 | +45 34 | 9.2 | 0.63 | G4 | G3 | 5.7 | 0.020 | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 646 | 17 Persei | $2^h45^m.4$ | +34° 39′ | 4.7 | 0″.077 | K5 | K1 | 0.7 | 0″.016 | 0″.010 | A |
| 650 | 2 Eridani | 2 46.5 | −21 25 | 4.8 | 0.053 | G8 | G5 | 1.2 | 0.019 | | |
| 653 | τ Persei | 2 47.2 | +52 21 | 4.1 | 0.008 | G1 | Go | −0.2 | 0.014 | | |
| 654 | 20 Persei A | 2 47.4 | +37 56 | 5.8† | 0.099 | Fo | F3 | 2.5 | 0.022 | 0.013 | Ye, S |
| 660 | 45 Arietis | 2 50.2 | +17 56 | 5.9 | 0.018 | Mc | G8 | −0.3 | 0.006 | 0.011 | W |
| 661 | ρ Arietis | 2 50.8 | +17 37 | 5.6 | 0.340 | F5 | F4 | 3.5 | 0.038 | | |
| 665 | η Eridani | 2 51.5 | − 9 18 | 4.0 | 0.229 | Ko | G9 | 1.4 | 0.030 | | |
| 667 | | 2 52.4 | +20 16 | 5.8 | 0.222 | F4 | F3 | 3.3 | 0.032 | | |
| 672 | | 2 53.0 | +46 49 | 5.6 | 0.035 | G3 | G3 | 0.5 | 0.009 | −0.007 | W |
| C388 | W.B. $2^b927$ | 2 55.2 | + 5 36 | 8.2 | 0.667 | K1 | G9 | 5.7 | 0.032 | 0.096 | Y |
| C392 | Lal. 5490 | 2 56.0 | +61 20 | 6.7 | 1.002 | G4 | G2 | 5.2 | 0.050 | 0.043 | Y, J |
| 691 | α Ceti | 2 57.1 | + 3 42 | 2.8 | 0.078 | Ma | G9 | −0.1 | 0.026 | 0.013 | A, M |
| 694 | γ Persei | 2 57.6 | +53 7 | 3.1 | 0.010 | F9 | F9 | −0.1 | 0.023 | 0.011 | A, M |
| 698 | ρ Persei | 2 58.8 | +38 27 | 3.7 | 0.173 | Mb | G7 | −0.8 | 0.013 | 0.048 | M, R |
| 707 | | 3 1.6 | − 6 29 | 5.6 | 0.002 | Ma | G9 | 0.1 | 0.008 | | |
| 710 | ι Persei | 3 1.8 | +49 14 | 4.2 | 1.269 | G1 | Go | 4.4 | 0.110 | 0.104 | Ye, S, Y, *et al.* |
| 712 | 54 Arietis | 3 2.7 | +18 25 | 6.5 | 0.042 | K6 | K2 | 0.5 | 0.006 | 0.031 | W |
| 713 | κ Persei | 3 2.7 | +44 29 | 4.0 | 0.240 | Ko | G8 | 0.9 | 0.024 | 0.037 | A |
| 717 | ω Persei | 3 4.8 | +39 14 | 4.8 | 0.022 | K1 | G9 | 0.5 | 0.013 | | |
| 718 | δ Arietis | 3 5.9 | +19 21 | 4.5 | 0.152 | Ko | G8 | 0.7 | 0.017 | | |
| 721 | 48 H Cephei | 3 7.6 | +77 22 | 5.5 | 0.083 | A7 | ..... | 1.6 | 0.017 | | |
| 722 | 94 Ceti | 3 7.7 | − 1 34 | 5.1 | 0.209 | F9 | F8 | 4.1 | 0.063 | | |
| 723 | α Fornacis Br. | 3 7.8 | −29 23 | 4.0 | 0.726 | F6 | F6 | 3.6 | 0.083 | | |
| C423 | B.D. +71°190 | 3 8.3 | +71 55 | 9.0 | 0.43 | G7 | G8 | 5.3 | 0.018 | 0.015 | G |
| C427 | W.B. $3^h113$ | 3 9.4 | + 8 37 | 7.7 | 0.578 | K1 | K1 | 6.1 | 0.048 | 0.079 | Y |
| 746 | | 3 12.5 | +33 51 | 4.9 | 0.013 | K2 | G8 | 0.2 | 0.012 | 0.012 | A |
| 752 | κ Ceti | 3 14.1 | + 3 0 | 5.0 | 0.282 | G5 | G4 | 4.9 | 0.096 | | |
| 755 | | 3 14.3 | +28 41 | 4.7 | 0.027 | K4 | Ko | 0.3 | 0.013 | | |
| 759 | 16 Eridani | 3 15.1 | −22 7 | 4.0 | 0.065 | Mb | G8 | 0.0 | 0.016 | | |
| 765 | | 3 16.0 | +64 14 | 5.6 | 0.019 | K2 | G5 | 1.3 | 0.013 | | |

TABLE VII—*Continued*

| Boss | Name | α 1900 | δ 1900 | Harv. Vis. Mag. | μ | Spectrum | | Spect. Abs. Mag. | Spect. π | Trig. π | Auth. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Est. | Meas. | | | | |
| 768 | 62 Arietis | $3^h16^m2$ | +27° 15′ | 5.6 | 0″.020 | G6 | G7 | 0.2 | 0″.008 | | |
| 770 | 63 Arietis | 3 17.0 | +20 23 | 5.2 | 0.050 | K4 | K2 | 0.4 | 0.011 | | |
| 772 | α Persei § | 3 17.2 | +49 30 | 1.9 | 0.039 | F5 | F8 | −1.3 | 0.023 | 0″.017 | Ye, M, F |
| 778 | o Tauri | 3 19.4 | + 8 41 | 3.8 | 0.103 | G7 | G4 | 0.1 | 0.018 | 0.006 | A |
| C453 | Lal. 6320 | 3 20.1 | − 5 42 | 8.1 | 0.816 | K5 | K5 | 7.2 | 0.066 | 0.062 | S, Y, J |
| 795 | σ Persei | 3 23.5 | +47 39 | 4.6 | 0.023 | K4 | K0 | 0.4 | 0.014 | 0.013 | A |
| 804 | 5 Tauri | 3 25.4 | +12 36 | 4.3 | 0.018 | G6 | G5 | 0.1 | 0.014 | | |
| 814 | ε Eridani | 3 28.2 | − 9 48 | 3.8 | 0.972 | K1 | K1 | 6.0 | 0.275 | 0.317 | M, Y, F |
| | A.G. Berlin 960 | 3 29.6 | +18 34 | 7.9 | 0.012‡ | Mb | G8 | 0.1 | 0.003 | | |
| 823 | Bu. 1787 Br | 3 31.7 | + 0 16 | 6.2† | 0.151 | G8p | G0 | 5.4 | 0.069 | 0.012 | M |
| 825 | 10 Tauri | 3 31.8 | + 0 5 | 4.4 | 0.536 | F9 | F9 | 3.6 | 0.069 | 0.058 | A, M, Y, J |
| 826 | | 3 33.5 | +62 54 | 5.3 | 0.022 | Ma | G7 | −0.5 | 0.007 | | |
| 831 | 21 Eridani | 3 34.1 | − 5 57 | 6.0 | 0.204 | K0 | G9 | 3.6 | 0.033 | | |
| 832 | | 3 34.5 | +59 39 | 6.0 | 0.002 | K2 | G7 | 2.0 | 0.016 | | |
| C489 | W.B. $3^h617$ | 3 35.3 | − 3 32 | 6.7 | 0.745 | F6 | F7 | 3.9 | 0.028 | 0.010 | M, Y |
| C499 | A.G. Chris. 631 | 3 38.2 | +68 21 | 9.2 | 0.30 | K8 | K3 | 9.0 | 0.091 | 0.074 | G |
| 847 | ν Persei | 3 38.4 | +42 16 | 3.9 | 0.009 | F5 | F5 | 0.6 | 0.022 | 0.021 | A, M |
| 848 | δ Eridani | 3 38.5 | −10 6 | 3.7 | 0.749 | G9 | G9 | 3.4 | 0.087 | 0.147 | M, Y, F |
| 862 | Bu. 1854 Br | 3 40.2 | +41 9 | 8.6† | 1.372 | K0 | G6 | 6.3 | 0.035 | 0.030 | M, Ye, D, *et al.* |
| 862 | Bu. 1854 Ft | 3 40.2 | +41 9 | 9.2 | 1.372 | K2 | K0 | 6.7 | 0.032 | | |
| 864 | | 3 40.4 | +65 13 | 4.7 | 0.004 | Ma | G5 | −0.6 | 0.009 | | |
| | B.D. +23°535 | 3 41.4 | +23 25 | 8.0 | ..... | F6 | F6 | 3.6 | 0.013 | | |
| | B.D. +23°542 | 3 41.7 | +23 18 | 8.3 | ..... | K1 | G9 | 2.4 | 0.007 | 0.065 | Y |
| 873 | 27 Eridani | 3 42.5 | −23 33 | 4.3 | 0.548 | F3 | F4 | 2.7 | 0.048 | 0.073 | M |
| C513 | W.B. $3^h811$ | 3 44.4 | + 1 4 | 8.6 | 0.67 | K1 | K0 | 5.7 | 0.026 | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C518 | B.D. +22°583 | $3^h46^m2$ | +22°23′ | 7.8 | 0″.388 | G5 | G4 | 5.2 | 0″.030 | 0″.039 | Ye |
| C521 | Lal. 7036 | 3 46.4 | +60 53 | 7.8 | 0.479 | K0 | G8 | 6.1 | 0.046 | 0.060 | J |
| 889 | | 3 46.4 | +48 21 | 5.9 | 0.058 | K0 | G8 | 0.8 | 0.009 | 0.020 | W |
| 892 | | 3 47.4 | +17 2 | 6.0 | 0.147 | F1 | F0 | 2.4 | 0.019 | | |
| 895 | | 3 48.4 | +75 53 | 8.3 | 0.646 | K6 | K5 | 8.4 | 0.105 | 0.060 | Ye, Y, K |
| 897 | Bu. 1927 | 3 48.6 | +60 49 | 5.3† | 0.016 | K4 | K0 | 0.3 | 0.010 | | |
| 901 | 32 Eridani Br. | 3 49.3 | − 3 15 | 5.0 | 0.034 | G4 | G4 | 0.2 | 0.011 | 0.005 | M |
| | A.G. Albany 1158 | 3 53.2 | + 1 10 | 7.9 | 0.008‡ | K1 | G9 | 0.8 | 0.004 | | |
| 915 | γ Eridani | 3 53.4 | −13 48 | 3.2 | 0.130 | K5 | K0 | 0.5 | 0.029 | 0.019 | M |
| 919 | | 3 55.0 | +17 55 | 5.8 | 0.141 | A8 | A9 | 2.2 | 0.019 | | |
| 927 | | 3 56.5 | +35 2 | 8.6 | 2.200 | K0 | G8 | 6.1 | 0.032 | 0.040 | Ye, S, Y, *et al.* |
| C542 | Bu. 2007 | 3 57.4 | +39 14 | 7.4† | 0.201 | G4 | G3 | 4.7 | 0.029 | | |
| 933 | 36 Tauri | 3 58.4 | +23 50 | 5.7 | 0.022 | F4p | F7 | 3.5 | 0.036 | 0.014 | W |
| 936 | 37 Tauri | 3 58.8 | +21 49 | 4.5 | 0.113 | K0 | G9 | 0.8 | 0.018 | −0.017 | A |
| 937 | | 3 58.9 | + 2 33 | 5.4 | 0.190 | F7 | F8 | 3.2 | 0.036 | | |
| 949 | 49 Persei | 4 1.6 | +37 28 | 6.2 | 0.214 | K1 | K0 | 2.4 | 0.017 | | |
| 950 | 50 Persei | 4 1.9 | +37 47 | 5.6 | 0.260 | F7 | F8 | 3.9 | 0.046 | 0.048 | A |
| C553 | Fed. 635 | 4 2.1 | +76 2 | 8.2 | 0.25 | K0 | G9 | 6.2 | 0.040 | 0.025 | G |
| 951 | | 4 2.3 | +17 4 | 6.1 | 0.024 | K5 | K4 | 0.4 | 0.007 | | |
| 952 | 43 Tauri | 4 3.3 | +19 21 | 5.7 | 0.114 | K1 | K0 | 1.4 | 0.014 | 0.024 | M |
| 955 | 44 Tauri | 4 4.7 | +26 13 | 5.6 | 0.046 | F1 | F2 | 2.2 | 0.021 | | |
| 960 | 37 Eridani | 4 5.5 | − 7 11 | 5.6 | 0.010 | G8 | G5 | 1.5 | 0.015 | | |
| 961 | 45 Tauri | 4 6.0 | + 5 16 | 5.7 | 0.143 | F4 | F4 | 3.1 | 0.030 | | |
| 963 | o Eridani | 4 7.0 | − 7 6 | 4.1 | 0.081 | A8 | A9 | 0.3 | 0.017 | | |
| 972 | 47 Tauri A | 4 8.5 | + 9 1 | 5.1† | 0.036 | G4 | G4 | 0.2 | 0.010 | | |
| C560 | A.G. Berlin 1366 | 4 8.6 | +22 6 | 9.1 | 0.54 | A8 | F2 | 2.8 | 0.006 | | |
| 977 | | 4 9.6 | +80 35 | 5.6 | 0.020 | G8 | G7 | 0.9 | 0.012 | | |
| 980 | 48 Tauri | 4 10.1 | +15 9 | 6.4 | 0.124 | F1 | F1 | 1.9 | 0.013 | | |
| 984 | 40 Eridani | 4 10.7 | − 7 49 | 4.5 | 4.085 | K1 | K0 | 6.2 | 0.219 | 0.196 | M, J, F, C |
| C570 | | 4 11.9 | +16 42 | 8.3 | 0.110 | G7 | G6 | 5.5 | 0.028 | | |

TABLE VII—*Continued*

| Boss | Name | α 1900 | δ 1900 | Harv. Vis. Mag. | μ | Spectrum | | Spect. Abs. Mag. | Spect. π | Trig. π | Auth. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Est. | Meas. | | | | |
| 1000 | γ Tauri | $4^h14^m1$ | +15°23′ | 3.9 | 0″.120 | G7 | G8 | 0.7 | 0″.023 | | |
| | 55 Tauri | 4 14.2 | +16 17 | 7.1† | 0.107 | F7 | F7 | 3.9 | 0.023 | | |
| 1002 | φ Tauri | 4 14.2 | +27 7 | 5.1 | 0.086 | K1 | G9 | 1.4 | 0.018 | | |
| 1014 | Bu. 2149 | 4 16.5 | +20 35 | 6.3† | 0.011 | Ma | G6 | 0.9 | 0.008 | 0″.001 | W |
| | Bu. 2154 | 4 17.1 | +14 49 | 7.2† | 0.096‡ | F9 | F9 | 4.1 | 0.024 | | |
| 1017 | δ Tauri | 4 17.2 | +17 18 | 3.9 | 0.115 | G9 | G7 | 0.4 | 0.020 | | |
| | B.D. +16°591 | 4 18.6 | +16 50 | 7.8 | 0.102 | F5 | F5 | 3.8 | 0.016 | | |
| C 582 | Lal. 8256 | 4 18.7 | +16 39 | 8.0 | 0.135 | Go | F9 | 4.0 | 0.016 | | |
| 1025 | | 4 19.1 | +18 49 | 6.0 | 0.123 | A9 | A8 | 2.0 | 0.016 | | |
| C 585 | Lal. 8248 | 4 20.1 | +46 38 | 6.7 | 0.317 | G4 | G3 | 3.9 | 0.028 | 0.002 | Jo |
| C 586 | Lal. 8311 | 4 20.4 | +15 18 | 7.4 | 0.115 | F8 | F8 | 3.9 | 0.020 | | |
| 1044 | ε Tauri | 4 22.8 | +18 58 | 3.6 | 0.120 | G9 | G8 | 1.0 | 0.030 | 0.028 | A |
| 1045 | $\theta^1$ Tauri | 4 22.9 | +15 44 | 4.0 | 0.108 | G9 | G8 | 1.4 | 0.030 | | |
| 1055 | 81 Tauri | 4 24.9 | +15 28 | 5.5 | 0.110 | F2 | F1 | 1.6 | 0.017 | | |
| 1058 | 85 Tauri | 4 26.1 | +15 38 | 6.0 | 0.109 | Fo | Fo | 2.5 | 0.020 | | |
| C 593 | Lal. 8610 | 4 29.2 | +16 47 | 7.4 | 0.11 | K3 | K2 | 1.0 | 0.005 | −0.036 | K |
| 1071 | 47 Eridani | 4 29.4 | − 8 26 | 5.4 | 0.035 | Ma | G7 | 0.7 | 0.011 | | |
| | A.G. Berlin 1228 | 4 29.6 | +19 46 | 7.2 | 0.033‡ | F8 | F7 | 3.2 | 0.016 | | |
| 1074 | 58 Persei § | 4 29.8 | +41 4 | 4.5 | 0.025 | G4p | F8 | −4.2: | 0.002 | 0.103 | Ye, D |
| C 594 | A.Oe. 4961 | 4 29.8 | +52 42 | 8.5 | 0.53 | K6 | K3 | 8.5 | 0.100 | | |
| 1077 | α Tauri | 4 30.2 | +16 18 | 1.1 | 0.203 | K4 | K2 | 1.0 | 0.096 | 0.055 | M, Ye, Y, *et al.* |
| | SZ Tauri § | 4 31.4 | +18 20 | 7.1 | 0.016‖ | F8p | F6 | −2.1 | 0.001 | | |
| 1086 | 89 Tauri | 4 32.4 | +15 50 | 5.8 | 0.094 | A8 | A7 | +2.1 | 0.018 | | |
| | B.D. +66°343 | 4 32.8 | +66 32 | 8.9 | 0.375‡ | G4 | G6 | 5.0 | 0.017 | 0.022 | G |
| 1091 | 53 Eridani | 4 33.6 | −14 30 | 4.0 | 0.179 | K1 | G8 | 1.9 | 0.038 | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C 602 | Groom. 864 | $4^h34^m5$ | +41°56′ | 7.3 | 0″690 | G2 | G1 | 5.6 | 0″046 | 0″027 | A, Y, Jo, F |
| 1098 | | 4 34.7 | −14 33 | 5.6 | 0.186 | K0 | G9 | 3.1 | 0.032 | | |
| 1100 | | 4 35.4 | +75 46 | 6.0 | 0.138 | A8 | ..... | 2.0 | 0.016 | | |
| 1105 | 54 Eridani | 4 36.1 | −19 52 | 4.5 | 0.094 | Ma | G9 | 0.1 | 0.013 | | |
| 1120 | | 4 40.5 | +18 33 | 6.1 | 0.091 | K3 | K3 | 0.5 | 0.008 | | |
| 1128 | | 4 42.7 | +63 20 | 5.8 | 0.111 | Mb | G9 | 0.5 | 0.009 | 0.002 | M |
| 1131 | | 4 42.8 | +18 33 | 6.8 | 0.440 | G0 | G0 | 5.0 | 0.044 | | |
| 1136 | 96 Tauri | 4 44.0 | +15 44 | 6.3 | 0.017 | K2 | G8 | 0.9 | 0.008 | | |
| C 619 | Groom. 884 | 4 44.4 | +45 41 | 7.1 | 0.676 | F9 | F9 | 5.7 | 0.052 | 0.086 | S, Y, R, J |
| 1140 | $\pi^3$ Orionis | 4 44.4 | + 6 47 | 3.3 | 0.471 | F5 | F6 | 3.7 | 0.120 | 0.156 | M |
| ..... | Bu. 2381 | 4 45.7 | +10 54 | 7.7† | ..... | G0 | F8 | 4.6 | 0.024 | 0.024 | A, S, F |
| ..... | Bu. 2383 | 4 46.2 | +13 29 | 6.8† | ..... | F9 | F6 | 4.0 | 0.028 | 0.007 | F |
| 1149 | 4 Orionis | 4 46.9 | +14 5 | 5.2 | 0.059 | Ma | G7 | 0.7 | 0.012 | | |
| 1154 | 5 Orionis | 4 48.2 | + 2 21 | 5.7 | 0.034 | Ma | K0 | 0.5 | 0.009 | 0.009 | W |
| 1164 | | 4 49.6 | +74 7 | 6.2 | 0.050 | K3 | K1 | 0.7 | 0.008 | | |
| ..... | SU Aurigae § | 4 49.6 | +30 24 | 8.7 | ..... | F7p | F8 | −1.1 | 0.001 | | |
| 1167 | ι Aurigae | 4 50.5 | +33 0 | 2.9 | 0.028 | K3 | K0 | 0.0 | 0.026 | −0.011 | F |
| 1168 | | 4 50.6 | −16 54 | 5.8 | 0.001 | G8 | G6 | 1.2: | 0.012 | | |
| C 634 | A.G. Leiden 1812 | 4 51.3 | +34 7 | 8.0 | 0.60 | G9 | G6 | 6.4 | 0.048 | | |
| 1175 | 99 Tauri | 4 51.7 | +23 48 | 6.0 | 0.025 | K0 | G8 | 1.5 | 0.012 | | |
| 1176 | 8 Camelop. | 4 51.8 | +53 0 | 6.4 | 0.012 | K3 | K0 | 0.7 | 0.008 | | |
| 1179 | | 4 52.7 | +66 41 | 6.3 | 0.355 | F7 | F6 | 3.9 | 0.033 | 0.000 | Jo |
| 1181 | 10 Orionis | 4 53.4 | + 1 34 | 4.7 | 0.006 | K2 | G9 | 0.2 | 0.012 | | |
| 1182 | 5 Aurigae | 4 53.4 | +39 15 | 6.0 | 0.013 | F0 | F3 | 2.5 | 0.020 | 0.002 | W |
| 1185 | β Camelop. § | 4 54.5 | +60 18 | 4.2 | 0.013 | F7p | F8 | −2.9 | 0.004 | | |
| ..... | RX Aurigae § | 4 54.5 | +39 49 | 7.6 | ..... | F9p | F7 | −1.7 | 0.001 | | |
| 1187 | ε Aurigae § | 4 54.8 | +43 41 | 3.4 | 0.014 | F5p | F9 | −2.0 | 0.008 | 0.060 | J |
| 1190 | ζ Aurigae | 4 55.5 | +40 56 | 3.9 | 0.032 | G8p | G1 | 1.6 | 0.035 | −0.007 | A, Ab |
| C 648 | W.B. $4^h1189$ | 4 55.9 | − 5 52 | 6.5 | 1.247 | K5 | K6 | 6.9 | 0.120 | 0.119 | M, S, W, *et al.* |
| 1196 | 12 Camelop. | 4 57.5 | +58 53 | 6.4 | 0.039 | G5 | G2 | 0.2 | 0.006 | | |

TABLE VII—*Continued*

| Boss | Name | α 1900 | δ 1900 | Harv. Vis. Mag. | μ | Spectrum | | Spect. Abs. Mag. | Spect. π | Trig. π | Auth. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Est. | Meas. | | | | |
| 1202 | 9 Aurigae | $4^h58^m8$ | +51°28′ | 5.0 | 0″.178 | F4 | F1 | 2.3 | 0″.029 | | |
| C 654 | Lal. 9428 | 5 0.0 | +64 48 | 6.4 | 0.190 | F2 | F4 | 2.8 | 0.019 | 0″.022 | G |
| 1211 | ϵ Leporis | 5 1.2 | −22 30 | 3.3 | 0.072 | K4 | K1 | 0.7 | 0.030 | 0.022 | M |
| 1212 | 104 Tauri | 5 1.5 | +18 31 | 5.0 | 0.540 | G0 | G1 | 4.4 | 0.076 | 0.045 | A, Y |
| 1217 | 13 Orionis | 5 2.2 | + 9 21 | 6.3 | 0.381 | G0 | G0 | 5.1 | 0.058 | | |
| 1219 | 14 Orionis | 5 2.5 | + 8 22 | 5.9† | 0.066 | F2 | F2 | 2.0 | 0.017 | 0.022 | S |
| 1221 | 107 Tauri | 5 2.9 | +19 44 | 6.6 | 0.018 | G5 | G3 | 0.6 | 0.006 | | |
| 1222 | | 5 3.3 | +46 50 | 5.6 | 0.170 | F3 | F3 | 2.3 | 0.022 | 0.032 | Jo |
| 1234 | | 5 5.9 | +15 55 | 5.4 | 0.004 | K6 | K1 | 0.5 | 0.010 | | |
| 1235 | 19 H Camelop | 5 6.1 | +79 7 | 5.2 | 0.174 | F5 | F6 | 3.0 | 0.036 | | |
| C 674 | W.B. $5^h87$ | 5 7.1 | − 9 13 | 8.0 | 0.57 | K0 | G9 | 5.8 | 0.036 | 0.049 | D |
| 1246 | α Aurigae | 5 9.3 | +45 54 | 0.7† | 0.437 | G1 | G1 | 0.1 | 0.076 | 0.067 | A, Y, Jo, *et al.* |
| 1247 | | 5 9.4 | + 5 2 | 5.8 | 0.017 | K3 | K0 | 0.7 | 0.010 | | |
| 1259 | λ Aurigae | 5 12.1 | +40 1 | 4.8 | 0.843 | G1 | G0 | 4.3 | 0.079 | 0.081 | A, M. S, *et al.* |
| 1267 | | 5 13.3 | +20 2 | 6.2 | 0.048 | K0 | G7 | 1.4 | 0.011 | 0.021 | W |
| C 683 | Lal. 9960 | 5 14.1 | − 3 11 | 8.6 | 0.722 | K5 | K4 | 7.1 | 0.050 | 0.074 | Y |
| 1309 | 17 Camelop | 5 20.7 | +62 59 | 5.8 | 0.005 | Ma | G8 | 0.7 | 0.010 | | |
| C 698 | Bu. 2745 Br | 5 23.3 | +54 35 | 7.6 | 0.409 | G1 | G1 | 5.5 | 0.038 | 0.024 | Ye |
| C 699 | Lal. 10299 | 5 23.5 | − 3 34 | 8.6 | 0.841 | K6 | K6 | 8.4 | 0.091 | 0.058 | Y, D |
| 1323 | β Leporis | 5 24.0 | −20 50 | 3.0 | 0.094 | G2 | G2 | −0.7 | 0.018 | 0.004 | M |
| 1334 | | 5 26.3 | +74 59 | 6.4 | 0.019 | K5 | K1 | 0.4 | 0.006 | 0.011 | A, Jo |
| C 705 | W.B. $5^h592$ | 5 26.4 | − 3 42 | 8.8 | 2.222 | Ma | ..... | 9.7 | 0.151 | 0.165 | M, S, Ye, *et al.* |
| C 706 | B.D. −0°981 | 5 26.6 | + 0 2 | 8.4 | 0.507 | G6 | G6 | 5.3 | 0.024 | | |
| 1347 | α Leporis § | 5 28.3 | −17 54 | 2.7 | 0.003 | F4p | F4 | −0.7 | 0.021 | 0.014 | M |
| 1348 | | 5 28.4 | +54 22 | 6.0 | 0.007 | K6 | K0 | 0.4 | 0.008 | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1360 | | $5^h29^m.9$ | +85° 9′ | 6.4 | 0″.020 | K4 | K1 | 0.7 | 0″.008 | | |
| C 709 | Groom. 990 | 5 30.4 | +51 23 | 7.9 | 0.563 | K2 | K0 | 6.3 | 0.048 | 0″.036 | A, M, Y, Jo |
| 1373 | 40 Orionis | 5 31.4 | + 9 14 | 4.4 | 0.321 | G7 | G6 | 1.6 | 0.028 | 0.029 | A, S, Ye |
| | A.G. Bonn 4626 | 5 32.3 | +42 37 | 7.4 | 0.038‡ | K4 | K1 | 0.6 | 0.004 | | |
| 1380 | | 5 32.4 | +65 39 | 5.8 | 0.024 | K4 | K1 | 0.7 | 0.010 | | |
| 1385 | | 5 33.2 | +53 26 | 6.4 | 0.510 | K0 | G9 | 5.7 | 0.072 | 0.100 | A, Y, Jo, Ab |
| C 714 | Groom. 986 | 5 33.3 | +74 34 | 7.3 | 0.240 | G4 | G3 | 3.7 | 0.019 | 0.021 | G |
| 1393 | 24 Camelop. | 5 34.5 | +56 32 | 6.2 | 0.037 | K0 | G8 | 2.3 | 0.017 | | |
| 1394 | 23 Camelop. | 5 34.9 | +61 26 | 6.4 | 0.002 | G5 | G5 | 0.2 | 0.006 | | |
| | A.G. Bonn 4686 | 5 37.0 | +43 31 | 7.7 | 0.033* | K0 | G6 | 2.8 | 0.010 | | |
| | A.G. Bonn 4698 | 5 38.4 | +42 49 | 8.0 | ..... | K2 | K1 | 0.0 | 0.003 | | |
| C 725 | Lal. 10797 | 5 39.2 | +37 15 | 7.3 | 0.706 | K1 | K0 | 5.7 | 0.048 | 0.086 | A, D, Y, J |
| 1419 | γ Leporis Ft. | 5 40.3 | −22 27 | 6.4 | 0.461 | K5 | K3 | 6.9 | 0.126 | 0.149 | M |
| 1420 | γ Leporis Br. | 5 40.3 | −22 29 | 3.8 | 0.468 | F6 | F5 | 3.8 | 0.100 | | |
| 1424 | 130 Tauri | 5 41.6 | +17 41 | 5.5 | 0.010 | F4 | F2 | 1.8 | 0.018 | | |
| 1429 | τ Aurigae | 5 42.2 | +39 9 | 4.6 | 0.035 | G5 | G7 | 0.3 | 0.014 | 0.014 | A |
| 1434 | 132 Tauri | 5 42.9 | +24 32 | 5.0 | 0.036 | K0 | G7 | 2.3 | 0.029 | | |
| 1439 | υ Aurigae | 5 44.2 | +37 17 | 5.0 | 0.052 | Ma | K0 | 0.0 | 0.010 | | |
| 1441 | | 5 44.5 | + 9 50 | 5.9 | 0.014 | G6 | G6 | 0.8 | 0.009 | | |
| 1442 | ν Aurigae | 5 44.6 | +39 7 | 4.2 | 0.008 | K0 | K0 | 0.2 | 0.016 | 0.022 | A |
| 1444 | | 5 44.7 | +27 56 | 5.6 | 0.009 | G7 | G7 | 0.1 | 0.008 | | |
| 1456 | δ Leporis | 5 47.0 | −20 53 | 3.9 | 0.696 | G7 | G6 | 1.5 | 0.033 | 0.024 | M |
| 1461 | χ Orionis | 5 48.5 | +20 15 | 4.6 | 0.208 | G1 | G1 | 4.4 | 0.091 | 0.105 | A, M |
| 1468 | α Orionis | 5 49.8 | + 7 23 | 0.9 | 0.029 | Ma | G3 | −3.8 | 0.012 | 0.021 | A, Y |
| C 739 | Lal. 11196 | 5 50.3 | +13 55 | 6.5 | 0.629 | G5 | G1 | 5.7 | 0.069 | 0.078 | A, Y |
| 1472 | δ Aurigae | 5 51.3 | +54 17 | 3.9 | 0.153 | G7 | G8 | 0.7 | 0.023 | 0.029 | A, M, Ye, *et al.* |
| 1476 | η Leporis | 5 51.9 | −14 11 | 3.8 | 0.138 | F3 | F4 | 2.6 | 0.058 | 0.036 | M |
| 1479 | π Aurigae | 5 52.5 | +45 56 | 4.6 | 0.011 | Mb | G6 | −0.8 | 0.008 | | |
| 1483 | | 5 53.0 | +44 35 | 6.4 | 0.051 | K2 | K1 | 1.1 | 0.009 | | |
| 1494 | | 5 55.1 | − 3 5 | 4.7 | 0.084 | K1 | G8 | 2.1 | 0.030 | | |

TABLE VII—*Continued*

| Boss | Name | α 1900 | δ 1900 | Harv. Vis. Mag. | μ | Spectrum | | Spect. Abs. Mag. | Spect. π | Trig. π | Auth. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Est. | Meas. | | | | |
| C 756 | A.G. Berlin 1866 | $5^h57^m.3$ | +19°23′ | 9.0 | 0″.93 | F9 | F9 | 4.9 | 0″.015 | | |
| 1508 | 1 Gemin | 5 58.0 | +23 16 | 4.3 | 0.108 | G4 | G3 | 2.1 | 0.036 | 0″.025 | A |
| 1511 | | 5 59.2 | −26 17 | 5.2 | 0.104 | K2 | G8 | 1.4 | 0.017 | | |
| C 760 | Lal. 11471 | 5 59.5 | +35 24 | 6.1 | 0.332 | G1 | G0 | 4.8 | 0.055 | 0.048 | A |
| 1513 | 63 Orionis | 5 59.6 | + 5 26 | 5.8 | 0.007 | G6 | G5 | 0.4 | 0.008 | | |
| 1514 | 66 Orionis | 5 59.7 | + 4 10 | 5.7 | 0.012 | G4 | G1 | −1.1 | 0.004 | | |
| C 761 | B.D. +26°1067 | 5 59.7 | +26 34 | 8.9 | 0.42 | K4 | K2 | 6.6 | 0.035 | 0.021 | Ye |
| | Groom. 1059 | 6 0.6 | +76 31 | 8.0† | 0.004 | F5 | F7 | 2.5 | 0.008 | | |
| 1549 | 6 Gemin | 6 6.3 | +22 56 | 6.3 | 0.027 | Ma | G4 | 0.8 | 0.008 | 0.003 | W |
| 1560 | 1 Lyncis | 6 8.7 | +61 33 | 5.3 | 0.005 | Mb | G5 | 0.6 | 0.011 | | |
| 1561 | η Gemin | 6 8.8 | +22 32 | 3.7 | 0.065 | Ma | G6 | −0.5 | 0.014 | 0.016 | A, M, R |
| 1564 | 71 Orionis | 6 9.0 | +19 11 | 5.2 | 0.224 | F6 | F5 | 2.9 | 0.035 | 0.039 | A |
| 1565 | κ Aurigae | 6 9.0 | +29 32 | 4.4 | 0.274 | G8 | G7 | 0.5 | 0.017 | 0.026 | A, Jo |
| C 780 | W.B. $6^h128$ | 6 9.6 | +44 45 | 8.6 | 0.41 | G9 | G8 | 6.4 | 0.036 | 0.102 | Ram |
| 1573 | 8 Gemin | 6 10.2 | +24 0 | 6.1 | 0.029 | G5 | G5 | 0.7 | 0.008 | | |
| 1576 | 43 Aurigae | 6 10.8 | +46 24 | 6.5 | 0.133 | K1 | K0 | 0.7 | 0.007 | 0.036 | Jo |
| 1577 | 74 Orionis | 6 10.8 | +12 18 | 5.1 | 0.212 | F5 | F4 | 3.4 | 0.046 | | |
| 1582 | | 6 12.0 | + 5 8 | 5.8 | 0.282 | G0 | F9 | 3.8 | 0.040 | 0.051 | A |
| 1596 | | 6 14.4 | +14 42 | 6.0 | 0.019 | K6 | K1 | 0.6 | 0.008 | | |
| 1599 | | 6 15.0 | − 2 54 | 5.2 | 0.009 | Ma | K0 | 0.0 | 0.009 | −0.004 | M |
| 1604 | μ Gemin | 6 16.9 | +22 34 | 3.2 | 0.128 | Ma | G6 | −0.8 | 0.016 | 0.026 | A, M |
| 1606 | 46 Aurigae § | 6 17.2 | +49 20 | 5.1 | 0.014 | K2p | G5 | −3.6 | 0.002 | | |
| 1608 | 5 Lyncis | 6 18.1 | +58 28 | 5.5 | 0.011 | K6 | K2 | 0.6 | 0.011 | | |
| | T Monocer. § | 6 19.8 | + 7 8 | 6.2 | 0.029‖ | G1p | G0 | −2.0 | 0.003 | | |
| 1622 | α Argus* | 6 21.7 | −52 38 | −0.9 | 0.018 | ..... | ..... | −3: | 0.038 | 0.007 | C |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1627..... | 6 Lyncis..... | $6^h 22^m.1$ | +58° 14′ | 6.0 | 0″.330 | G8 | G7 | 2.9 | 0″.024 | 0″.004 | A, Ab, Jo |
| 1629..... | RT Aurigae § ..... | 6 22.1 | +30 33 | 5.3 | 0.024 | F8p | F5 | −1.9 | 0.003 | 0.031 | W, S |
| 1632..... | 47 Aurigae..... | 6 22.6 | +46 45 | 6.0 | 0.007 | K5 | K1 | 0.5 | 0.008 | 0.017 | M |
| 1643..... | ..... | 6 24.9 | +78 5 | 5.9 | 0.019 | K5 | K1 | 0.7 | 0.009 | 0.017 | W |
| 1646..... | WW Aurigae ..... | 6 25.9 | +32 32 | 6.6† | 0.035 | A7p | ..... | 1.9 | 0.012 | | |
| 1653..... | 12 Monocer..... | 6 27.0 | + 4 56 | 6.0 | 0.027 | G8 | G7 | 0.9 | 0.009 | | |
| 1665..... | 8 Lyncis..... | 6 28.6 | +61 34 | 6.0 | 0.341 | G8 | G6 | 2.9 | 0.024 | 0.035 | A, Jo |
| 1673..... | 23 H Camelop..... | 6 29.2 | +79 40 | 5.6 | 0.620 | F7 | F8 | 4.2 | 0.052 | 0.037 | Y |
| ..... | W Gemin. §..... | 6 29.2 | +15 24 | 7.1 | 0.009‖ | Gop | F6 | −2.6 | 0.001 | | |
| ..... | Bu. 3474..... | 6 30.2 | +27 22 | 7.0† | 0.061* | Go | Go | 4.3 | 0.029 | 0.040 | A, S |
| 1687..... | 51 Aurigae..... | 6 31.7 | +39 29 | 5.7 | 0.119 | K3 | K1 | 1.1 | 0.012 | | |
| ..... | W.B. $6^h$886..... | 6 32.0 | +12 14 | 8.3 | ..... | F1 | A9 | 1.8 | 0.005 | −0.021 | Ye |
| 1704..... | 25 Gemin..... | 6 35.0 | +28 17 | 6.5 | 0.017 | G5 | Go | −1.2 | 0.003 | | |
| 1707..... | 55 Aurigae..... | 6 35.8 | +44 37 | 5.2 | 0.055 | K5 | K2 | 0.8 | 0.013 | | |
| C 824..... | Lal. 12831..... | 6 37.3 | +40 44 | 6.9 | 0.171 | Mb | G7 | 0.4 | 0.005 | −0.004 | Jo |
| 1717..... | ε Gemin..... | 6 37.8 | +25 14 | 3.2 | 0.020 | G8 | G2 | −1.4 | 0.012 | 0.009 | A, M |
| 1721..... | 30 Gemin..... | 6 38.3 | +13 20 | 4.6 | 0.076 | K2 | Ko | 1.0 | 0.019 | | |
| 1724..... | 56 Aurigae..... | 6 39.5 | +43 41 | 5.3 | 0.158 | F9 | F9 | 4.3 | 0.063 | 0.077 | A, Jo |
| 1725..... | ξ Gemin..... | 6 39.7 | +13 0 | 3.4 | 0.231 | F3 | F6 | 2.0 | 0.052 | 0.051 | A, M |
| 1732..... | α Can. Maj..... | 6 40.7 | −16 35 | −1.58 | 1.316 | A3 | ..... | 1.3: | 0.376 | 0.376 | F, C |
| 1740..... | 18 Monocer..... | 6 42.6 | + 2 31 | 4.7 | 0.026 | Ko | G9 | 0.2 | 0.013 | 0.024 | A |
| 1756..... | 35 Gemin..... | 6 44.8 | +13 32 | 5.9 | 0.013 | K3 | Ko | 0.8 | 0.010 | | |
| 1758..... | 24 H Camelop..... | 6 45.5 | +77 6 | 4.8 | 0.085 | K5 | K5 | 0.3 | 0.013 | | |
| C 834..... | Lal. 13284..... | 6 47.4 | − 5 3 | 6.8 | 0.582 | K5 | K4 | 7.1 | 0.115 | 0.121 | Y |
| 1776..... | Bu. 3678..... | 6 48.6 | +58 33 | 4.9 | 0.134 | G4 | G4 | 0.1 | 0.011 | 0.029 | S |
| 1778..... | 38 Gemin..... | 6 49.0 | +13 18 | 4.7 | 0.112 | A8 | A8 | 2.4 | 0.035 | 0.049 | A |
| 1783..... | θ Can. Maj..... | 6 49.5 | −11 55 | 4.2 | 0.138 | K4 | K1 | 0.8 | 0.021 | 0.017 | Ye |
| C 837..... | A.G. Bonn 5621..... | 6 49.5 | +40 13 | 8.3 | 0.43 | K5 | K4 | 7.3 | 0.063 | | |
| C 841..... | W.B. $6^h$1500..... | 6 51.4 | + 1 18 | 7.7 | 0.570 | G6 | G3 | 5.6 | 0.038 | 0.006 | Y |
| ..... | Groom. 1239..... | 6 51.9 | +69 21 | 7.5 | 0.005 | Ma | G8 | 0.7 | 0.004 | | |

TABLE VII—*Continued*

| Boss | Name | α 1900 | δ 1900 | Harv. Vis. Mag. | μ | Spectrum | | Spect. Abs. Mag. | Spect. π | Trig. π | Auth. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Est. | Meas. | | | | |
| 1801 | 51 H Cephei | $6^h53^m.7$ | +87°12′ | 5.3 | 0″.051 | Ma | G9 | 0.4 | 0″.011 | | |
| C 847 | Lal. 13427 | 6 54.0 | +48 32 | 8.2 | 0.697 | K4 | K2 | 6.6 | 0.048 | 0″.032 | M, Ye, Y |
| 1809 | | 6 57.2 | +29 30 | 6.0 | 0.838 | G2 | G1 | 5.1 | 0.066 | 0.061 | A, Y, F |
| 1815 | ζ Gemin. § | 6 58.2 | +20 43 | 4.0 | 0.009 | Gop | F9 | −3.4 | 0.003 | 0.015 | A, S, Ab |
| 1818 | | 6 59.2 | − 5 11 | 5.9 | 0.006 | K2 | G6 | 0.5 | 0.008 | | |
| 1822 | | 6 59.6 | +34 38 | 5.6 | 0.087 | G4 | G4 | 0.1 | 0.008 | 0.036 | W |
| C 859 | Lal. 13792 | 7 3.5 | +25 54 | 7.0 | 0.225 | G5 | G4 | 4.8 | 0.036 | 0.031 | A |
| C 861 | Lal. 13849 | 7 4.2 | +21 25 | 6.5 | 0.510 | G9 | G7 | 4.6 | 0.042 | 0.042 | A, S, Y |
| 1839 | δ Can. Maj. § | 7 4.3 | −26 14 | 2.0 | 0.005 | G2p | Go | −2.9 | 0.010 | −0.059 | F |
| 1840 | τ Gemin. | 7 4.8 | +30 25 | 4.5 | 0.053 | K3 | K2 | 0.5 | 0.016 | 0.010 | A |
| 1841 | 63 Aurigae | 7 4.8 | +39 29 | 5.1 | 0.048 | K3 | K1 | 1.0 | 0.015 | | |
| 1846 | | 7 5.6 | +51 36 | 5.7 | 0.019 | Mb | G9 | 0.1 | 0.008 | 0.002 | M, W |
| 1854 | 18 Lyncis | 7 7.2 | +59 49 | 5.3 | 0.272 | K2 | Ko | 1.3 | 0.016 | 0.036 | A |
| 1856 | 51 Gemin. | 7 7.6 | +16 20 | 5.3 | 0.051 | Mb | G7 | 0.1 | 0.009 | | |
| 1860 | | 7 8.4 | +47 25 | 5.6 | 0.184 | F9 | F9 | 5.0 | 0.076 | 0.069 | Jo |
| 1861 | 52 Gemin. | 7 8.6 | +25 4 | 6.0 | 0.105 | K7 | K4 | 0.4 | 0.008 | | |
| 1868 | 53 Gemin. | 7 9.7 | +28 4 | 5.9 | 0.020 | Ma | K2 | −0.2 | 0.006 | 0.008 | W |
| 1873 | 24 Monocer | 7 10.2 | + 0 1 | 6.5 | 0.019 | G5 | G5 | −0.2 | 0.005 | | |
| C 873 | Lal. 14146 | 7 11.3 | −12 53 | 7.7 | 0.513 | F9 | F9 | 3.9 | 0.017 | 0.051 | M, Y |
| 1898 | δ Gemin. | 7 14.2 | +22 10 | 3.5 | 0.025 | A7 | ..... | 1.1 | 0.033 | 0.062 | A, M |
| 1909 | R Can. Maj. | 7 14.9 | −16 12 | 6.0† | 0.212 | A9 | Fo | 1.7 | 0.014 | | |
| 1912 | 65 Aurigae | 7 15.4 | +36 57 | 5.2 | 0.089 | K1 | G9 | 1.2 | 0.016 | | |
| 1919 | 66 Aurigae | 7 17.2 | +40 52 | 5.3 | 0.024 | Ko | G8 | −0.3 | 0.008 | −0.061 | Ab |
| 1926 | 59 Gemin. | 7 18.3 | +27 50 | 5.7 | 0.020 | Fo | F2 | 1.3 | 0.013 | | |
| 1931 | ι Gemin. | 7 19.5 | +28 0 | 3.9 | 0.145 | G8 | G8 | 0.5 | 0.021 | 0.026 | A, M |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1937 | ..... | $7^h20^m5$ | +68°40′ | 5.8 | 0″044 | K0 | G7 | 1.8 | 0″016 | | |
| 1940 | ..... | 7 20.9 | +21 44 | 6.4 | 0.309 | F5 | F6 | 3.9 | 0.032 | 0″040 | A |
| 1945 | 63 Gemin. | 7 21.8 | +21 39 | 5.3 | 0.133 | F3 | F5 | 2.8 | 0.032 | | |
| 1952 | $\rho$ Gemin. | 7 22.7 | +31 59 | 4.2 | 0.236 | A9 | F1 | 1.5 | 0.029 | 0.055 | M, Jo |
| 1962 | 6 Can. Min. | 7 24.2 | +12 13 | 4.8 | 0.019 | K3 | K0 | 0.4 | 0.013 | 0.024 | A |
| 1963 | ..... | 7 24.3 | − 1 42 | 5.8 | 0.011 | K3 | G8 | 0.8 | 0.010 | | |
| 1971 | ..... | 7 26.0 | +17 18 | 5.6 | 0.089 | K1 | K0 | 0.7 | 0.011 | 0.000 | W |
| ..... | Groom. 1324 | 7 26.3 | +66 41 | 7.5 | 0.017 | Mb | G9 | 0.6 | 0.004 | | |
| ..... | Comp. $\alpha$ Gemin.* | 7 28.2 | +32 8 | 9.4† | 0.203 | Mdp | ..... | 9.2 | 0.091 | 0.079 | A, M, Ye, *et al.* |
| 1987 | $\upsilon$ Gemin. | 7 29.8 | +27 7 | 4.2 | 0.119 | K6 | K2 | 0.5 | 0.018 | 0.015 | A |
| 1999 | 25 Monocer. | 7 32.3 | − 3 53 | 5.2 | 0.072 | F4 | F5 | 1.3 | 0.017 | | |
| 2000 | 23 Lyncis. | 7 32.6 | +57 19 | 6.2 | 0.018 | K4 | K0 | 0.4 | 0.007 | | |
| 2001 | $o$ Gemin. | 7 32.6 | +34 49 | 4.9 | 0.125 | F0 | F1 | 0.8 | 0.015 | 0.023 | A, Ab |
| 2005 | 74 Gemin. | 7 33.7 | +17 54 | 5.2 | 0.004 | K8 | K0 | −0.3 | 0.008 | | |
| 2006 | ..... | 7 33.8 | +48 22 | 5.8 | 0.144 | G7 | G8 | 0.2 | 0.008 | 0.011 | A |
| 2008 | $\alpha$ Can. Min. | 7 34.1 | + 5 29 | 0.5 | 1.242 | F3 | F5 | 3.2 | 0.347 | 0.309 | M, S, Ye, *et al.* |
| 2020 | ..... | 7 36.4 | +14 27 | 5.8 | 0.015 | Ma | G6 | −0.4 | 0.006 | 0.006 | W |
| 2021 | $\gamma$ Monocer. | 7 36.5 | − 9 19 | 4.1 | 0.079 | K0 | G9 | 0.4 | 0.018 | 0.005 | M |
| 2023 | $\sigma$ Gemin. | 7 37.1 | +29 8 | 4.3 | 0.247 | K1p | G7 | 2.6 | 0.046 | 0.027 | A, Ye, Jo |
| 2024 | 51 Camelop. | 7 37.1 | +65 42 | 6.0 | 0.046 | K2 | K1 | 0.8 | 0.009 | | |
| C 922 | W.B. $7^h1029$ | 7 38.1 | +39 49 | 6.8 | 0.68 | F6 | F8 | 3.8 | 0.025 | 0.025 | Ye |
| 2029 | $\kappa$ Gemin. | 7 38.4 | +24 38 | 3.7 | 0.066 | G7 | G6 | 0.9 | 0.028 | 0.024 | A, M |
| 2031 | $\beta$ Gemin. | 7 39.2 | +28 16 | 1.2 | 0.625 | G9 | G8 | 1.7 | 0.126 | 0.064 | Y |
| 2034 | ..... | 7 39.8 | +80 31 | 6.5 | 0.478 | G9 | G6 | 4.8 | 0.046 | 0.049 | G, Y |
| 2049 | $\pi$ Gemin. | 7 41.1 | +33 40 | 5.3 | 0.040 | Ma | K0 | 0.3 | 0.010 | 0.028 | Ab |
| 2051 | 4 Puppis. | 7 41.3 | −14 19 | 5.1 | 0.017 | A8 | ..... | 1.6 | 0.020 | | |
| 2065 | $\xi$ Puppis § | 7 45.1 | −24 37 | 3.5 | 0.007 | G6p | G1 | −4.2: | 0.003 | | |
| 2075 | Bu. 4310 | 7 47.1 | −13 38 | 5.7 | 0.344 | G0 | G0 | 5.2 | 0.079 | 0.079 | M, S, F |
| 2076 | 25 Lyncis. | 7 47.2 | +47 39 | 6.4 | 0.017 | K1 | G8 | 0.4: | 0.006 | | |
| C 935 | Lal. 15290 | 7 47.2 | +30 55 | 8.2 | 1.962 | F9 | F8 | 4.7 | 0.020 | 0.055 | A, Y, M, *et al.* |

TABLE VII—*Continued*

| Boss | Name | α 1900 | δ 1900 | Harv. Vis. Mag. | μ | Spectrum | | Spect. Abs. Mag. | Spect. π | Trig. π | Auth. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Est. | Meas. | | | | |
| 2079 | 26 Lyncis | $7^h47^m4$ | +47° 49′ | 5.7 | 0″.043 | K4 | K1 | 0.4 | 0″.009 | | |
| | Lal. 15389 | 7 47.8 | −13 36 | 6.9 | 0.101* | Ko | G9 | 2.0 | 0.011 | | |
| 2084 | | 7 48.2 | +74 11 | 5.6 | 0.034 | K3 | K1 | 0.8 | 0.011 | | |
| C 940 | Lal. 15394 | 7 49.1 | +19 31 | 7.9 | 0.471 | K4 | K3 | 6.5 | 0.052 | 0″.075 | D |
| 2098 | 1 Cancri | 7 51.3 | +16 3 | 6.0 | 0.056 | K3 | K3 | 0.8 | 0.009 | | |
| C 947 | Lal. 15547 | 7 53.7 | +21 8 | 8.6 | 0.573 | G9 | Ko | 5.6 | 0.025 | 0.089 | Y |
| C 949 | Lal. 15565 | 7 54.3 | +29 31 | 6.9 | 1.170 | G7 | G4 | 5.9 | 0.063 | 0.066 | A, Ye, Y |
| 2117 | 2 Cancri | 7 54.9 | +25 40 | 5.9 | 0.014 | G8 | G7 | −0.6 | 0.005 | | |
| 2118 | 3 Cancri | 7 55.1 | +17 35 | 5.8 | 0.015 | K4 | Ko | 0.4 | 0.008 | | |
| 2130 | | 7 57.1 | + 2 37 | 4.5 | 0.106 | K2 | G9 | 1.1 | 0.021 | 0.030 | A, S |
| C 952 | Fed. 1221 | 7 57.2 | +72 13 | 8.0 | 0.496 | Go | G2 | 5.7 | 0.035 | | |
| 2131 | χ Gemin | 7 57.4 | +28 4 | 5.0 | 0.056 | K3 | K1 | 0.3 | 0.012 | | |
| C 955 | Bu. 4414 | 7 58.8 | +12 35 | 8.6† | 0.141 | Ko | G9 | 3.2 | 0.008 | 0.088 | S |
| 2144 | 9 Cancri | 8 0.4 | +22 55 | 6.2 | 0.024 | Mb | G7 | 0.4 | 0.007 | | |
| 2146 | μ Cancri | 8 1.9 | +21 52 | 5.4 | 0.085 | G3 | G1 | 3.7 | 0.046 | | |
| 2148 | | 8 2.5 | +42 43 | 6.4 | 0.073 | K3 | K2 | 0.8 | 0.008 | −0.030 | Ab |
| 2150 | 55 Camelop | 8 2.9 | +68 46 | 5.5 | 0.006 | G4 | G4 | −0.7 | 0.006 | | |
| 2153 | ρ Puppis § | 8 3.3 | −24 1 | 2.9 | 0.100 | F7p | F6 | −2.1 | 0.010 | 0.031 | M |
| 2155 | 29 Monocer. § | 8 3.6 | − 2 42 | 4.4 | 0.025 | G3p | F9 | −4.2: | 0.002 | | |
| 2157 | 14 Cancri | 8 4.4 | +25 49 | 5.8 | 0.361 | G5 | G5 | 3.2 | 0.030 | 0.036 | A |
| 2161 | | 8 5.4 | +32 46 | 7.0 | 0.807 | G6 | G2 | 5.8 | 0.058 | 0.046 | M, Y, Jo |
| 2168 | ζ Cancri A | 8 6.5 | +17 57 | 5.6 | 0.155 | F9 | F9 | 3.5 | 0.038 | 0.038 | Ye, S, F |
| 2169 | ζ Cancri C | 8 6.5 | +17 57 | 6.0 | 0.155 | Go | F9 | 4.4 | 0.048 | | |
| 2174 | | 8 7.0 | +76 4 | 5.7 | 0.027 | G6 | G7 | 0.3 | 0.008 | | |
| 2183 | 20 Puppis | 8 8.7 | −15 29 | 5.0 | 0.015 | G3 | G1 | −2.0 | 0.004 | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2193 | 57 Camelop. | $8^h10^m6$ | +62°49′ | 5.8 | 0″.018 | G6 | G5 | 0.9 | 0″.010 | | |
| 2195 | $\beta$ Cancri. | 8 11.1 | + 9 30 | 3.8 | 0.075 | K4 | K1 | 0.4 | 0.021 | 0″.003 | A, M |
| C 977 | W.B. $8^h181$ | 8 12.0 | +30 56 | 8.6 | 0.873 | K5 | K5 | 7.2 | 0.052 | 0.014 | Y, F |
| 2199 | | 8 13.7 | −12 18 | 6.0 | 1.030 | Ko | G7 | 6.2 | 0.110 | 0.081 | M, S, Y, F |
| 2202 | $\chi$ Cancri. | 8 14.0 | +27 32 | 5.2 | 0.388 | F7 | F7 | 3.6 | 0.048 | 0.066 | A, S |
| 2203 | | 8 14.3 | + 60 57 | 6.5 | 0.011 | Ko | G8 | 2.4 | 0.015 | | |
| 2208 | 31 Lyncis. | 8 16.0 | +43 31 | 4.4 | 0.107 | K5 | K1 | 0.7 | 0.018 | 0.009 | A, Ab |
| C 982 | A.Oe. 8869 | 8 16.3 | +66 48 | 8.9 | 0.52 | K4 | K3 | 6.4 | 0.032 | | |
| 2218 | 20 Cancri. | 8 17.6 | +18 39 | 5.9 | 0.064 | F1 | ..... | 1.9 | 0.016 | | |
| 2220 | | 8 17.9 | +42 20 | 6.2 | 0.011 | K6 | G8 | 0.5 | 0.008 | | |
| 2223 | 21 Cancri | 8 18.5 | +10 57 | 6.3 | 0.021 | Ma | G8 | 0.4 | 0.007 | | |
| 2224 | 298 G Puppis §. | 8 18.6 | −26 2 | 5.9 | 0.017 | F5p | F2 | −2.0 | 0.003 | | |
| 2227 | 1 Hydrae | 8 19.6 | − 3 26 | 5.7 | 0.216 | F1 | F3 | 3.6 | 0.038 | | |
| 2229 | 25 Cancri. | 8 20.2 | +17 23 | 6.2 | 0.246 | F4 | F4 | 2.8 | 0.021 | | |
| 2231 | | 8 20.3 | +67 38 | 6.0 | 0.056 | G7 | G7 | 1.4 | 0.012 | | |
| 2234 | | 8 20.5 | + 7 53 | 5.2 | 0.043 | G5 | G4 | −0.4 | 0.008 | | |
| 2236 | | 8 20.6 | +45 59 | 6.3 | 0.362 | G6 | Go | 4.9 | 0.052 | | |
| 2245 | 27 Cancri. | 8 21.2 | +12 59 | 5.8 | 0.116 | Mb | G4 | 0.3 | 0.008 | 0.029 | W |
| 2247 | o Urs. Maj | 8 22.0 | +61 3 | 3.5 | 0.166 | G2 | G2 | −0.8 | 0.014 | 0.002 | A, F |
| 2268 | | 8 26.4 | +38 22 | 6.0 | 0.204 | K3 | K2 | 0.7 | 0.009 | | |
| 2272 | 32 Lyncis. | 8 26.9 | +36 47 | 6.1 | 0.139 | F3 | F4 | 3.1: | 0.025 | 0.088 | Jo |
| 2275 | 32 Cancri. | 8 27.1 | +24 25 | 6.4 | 0.091 | G9 | G7 | 0.7 | 0.008 | | |
| ..... | A.G. Cam. 3181 | 8 28.2 | +54 4 | 8.7 | ..... | G8 | G7 | 2.9 | 0.007 | | |
| 2278 | | 8 28.6 | +73 59 | 6.3 | 0.106 | G8 | G8 | 1.6 | 0.011 | | |
| C1000 | W.B. $8^h596$ | 8 28 8 | +42 6 | 8.6 | 0.66 | K4 | K2 | 6.7 | 0.042 | 0.022 | Ye |
| 2282 | 35 Cancri. | 8 29.6 | +19 56 | 6.6 | 0.045 | F5 | F7 | 1.7 | 0.011 | | |
| 2285 | Bu. 4677 Br. | 8 30.5 | + 6 58 | 6.0 | 0.195 | F8 | F7 | 4.0 | 0.040 | 0.024 | W |
| 2286 | Bu. 4677 Ft. | 8 30.5 | + 6 58 | 7.2 | 0.201 | G4 | G4 | 5.5 | 0.046 | | |
| 2289 | | 8 30.9 | +53 45 | 5.7 | 0.072 | G4 | G4 | 0.7 | 0.010 | | |
| 2290 | $\pi$ Urs. Maj. | 8 31.5 | +64 41 | 4.8 | 0.052 | K2 | G9 | 1.0 | 0.017 | 0.018 | A |

TABLE VII—*Continued*

| Boss | Name | α 1900 | δ 1900 | Harv. Vis. Mag. | μ | Spectrum | | Spect. Abs. Mag. | Spect. π | Trig. π | Auth. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Est. | Meas. | | | | |
| 2293 | | $8^h31^m9$ | +53° 4′ | 6.0 | 0″.040 | K2 | K1 | 1.2 | 0″.011 | −0″.028 | A |
| 2294 | | 8 32.1 | +33 9 | 6.1 | 0.023 | K2 | G9 | 0.7 | 0.008 | | |
| C1008 | Lal. 16933 | 8 32.2 | +26 24 | 7.6 | 0.237 | G1 | G1 | 4.5 | 0.024 | 0.027 | A |
| C1012 | Lal. 16904 | 8 33.1 | +56 2 | 8.1 | 0.470 | G5 | G2 | 5.4 | 0.029 | −0.042 | Y |
| 2302 | σ Hydrae | 8 33.5 | + 3 42 | 4.5 | 0.027 | K2 | K0 | −0.1 | 0.012 | 0.019 | A |
| C1014 | Lal. 17046 | 8 34.4 | +11 53 | 7.9 | 0.531 | K2 | K0 | 6.3 | 0.048 | 0.031 | M |
| 2312 | Bu. 4714 Br. | 8 34.8 | −22 19 | 5.4 | 0.478 | G6 | G5 | 3.1 | 0.035 | −0.042 | F |
| | A.G. Leiden 3622 | 8 35.8 | +33 44 | 8.5 | ..... | K2 | K1 | 1.3 | 0.004 | | |
| 2321 | 9 Hydrae | 8 37.1 | −15 35 | 5.0 | 0.099 | K0 | K0 | 2.4: | 0.030 | | |
| 2333 | | 8 38.6 | +42 3 | 8.2 | 0.702 | K4 | K3 | 7.1 | 0.060 | 0.049 | S, Y |
| 2335 | 31 Monocer. | 8 38.8 | − 6 52 | 4.7 | 0.007 | G2 | F7 | 1.1 | 0.019 | | |
| 2336 | δ Cancri | 8 39.0 | +18 31 | 4.2 | 0.240 | G9 | G9 | 0.8 | 0.021 | 0.018 | A, M |
| 2338 | 46 Cancri | 8 39.2 | +31 4 | 6.1 | 0.020 | G3 | G3 | −1.0 | 0.004 | 0.007 | W |
| | A.G. Leiden 3648 | 8 39.3 | +33 36 | 8.0 | 0.011‡ | K2 | G8 | 1.1 | 0.004 | | |
| 2348 | ι Cancri | 8 40.6 | +29 8 | 4.2 | 0.054 | G5 | G5 | −1.3 | 0.008 | 0.028 | A, M |
| 2354 Br. | ε Hydrae AB | 8 41.5 | + 6 47 | 3.5† | 0.196 | F9 | G0 | 2.1 | 0.052 | 0.017 | A, M, S, Ait |
| 2354 Ft. | ε Hydrae C | 8 41.5 | + 6 47 | 7.5 | 0.196 | F5 | F7 | 3.5 | 0.016 | | |
| C1040 | Bu. 4815 S | 8 46.0 | +71 11 | 8.7 | 1.390 | K6 | K5 | 8.7 | 0.100 | 0.086 | G, F |
| | Bu. 4815 N | 8 46.0 | +71 11 | 9.1 | 1.390 | K9 | K5 | 9.2 | 0.105 | | |
| 2378 | 53 Cancri | 8 46.5 | +28 38 | 6.3 | 0.022 | Mb | G7 | 0.8 | 0.008 | 0.000 | M |
| 2380 | 55 Cancri | 8 46.6 | +28 43 | 6.1 | 0.541 | K2 | K1 | 5.7 | 0.083 | 0.080 | A, M, Y, Jo |
| 2384 | Bu. 4839 Ft. | 8 48.1 | +30 57 | 6.6 | 0.051 | K0 | G9 | 0.9 | 0.007 | | |
| 2384 | Bu. 4839 Br. | 8 48.1 | +30 57 | 6.1 | 0.051 | G9 | G8 | 0.0 | 0.006 | | |
| C1050 | W.B. $8^h1147$ | 8 49.0 | +26 35 | 6.7 | 0.44 | G1 | G1 | 4.2 | 0.032 | 0.018 | Ye |
| 2393 | ζ Hydrae | 8 50.1 | + 6 20 | 3.3 | 0.104 | G5 | G7 | −0.9 | 0.014 | 0.017 | A, M |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2394 | 60 Cancri | $8^h50^m5$ | +12° 0′ | 5.7 | 0″.021 | K4 | K0 | 0.6 | 0″.010 | | |
| 2404 | ι Urs. Maj. | 8 52.4 | +48 26 | 3.1 | 0.502 | A5 | ..... | 1.9 | 0.058 | 0″.090 | Y, Ab, F |
| 2410 | ..... | 8 53.5 | +18 31 | 6.6 | 0.089 | Mc | G9 | 0.2 | 0.005 | | |
| 2411 | ρ Urs. Maj. | 8 53.5 | +68 1 | 5.0 | 0.021 | Ma | K1 | −0.1 | 0.009 | | |
| 2412 | ..... | 8 54.0 | −15 45 | 5.9 | 0.324 | F5 | F5 | 3.9 | 0.040 | | |
| 2413 | 10 Urs. Maj. | 8 54.2 | +42 11 | 4.1 | 0.504 | F3 | F6 | 3.2 | 0.066 | 0.066 | A, S, Y, F |
| 2437 | ..... | 9 0.2 | +38 51 | 4.7 | 0.043 | G3 | G3 | −2.7 | 0.003 | 0.007 | A |
| 2441 | 13 Urs. Maj. | 9 1.6 | +67 32 | 4.9 | 0.070 | F5 | F6 | 3.8 | 0.060 | | |
| 2442 | Bu. 4929 Br. | 9 1.7 | +23 23 | 7.3 | 0.161 | F3 | F5 | 3.5 | 0.017 | 0.019 | W |
| 2442 | Bu. 4929 Ft. | 9 1.7 | +23 23 | 7.7 | 0.161 | F4 | F4 | 3.5 | 0.014 | | |
| 2447 | 75 Cancri | 9 2.9 | +27 3 | 6.0 | 0.404 | G2 | G2 | 4.1 | 0.042 | | |
| 2449 | ξ Cancri | 9 3.6 | +22 27 | 5.2 | 0.008 | K0 | G8 | 0.8 | 0.013 | | |
| 2450 | κ Pyxidis | 9 3.7 | −25 27 | 4.8 | 0.040 | K3 | G9 | 1.1: | 0.018 | | |
| C1083 | Lal. 18067 | 9 3.8 | −14 44 | 7.3 | 0.557 | G0 | G0 | 4.9 | 0.033 | | |
| 2455 | 79 Cancri | 9 4.6 | +22 24 | 6.1 | 0.010 | G8 | G6 | 2.1 | 0.016 | | |
| 2464 | 81 Cancri | 9 6.8 | +15 24 | 6.4 | 0.576 | G9 | G6 | 5.5 | 0.066 | 0.044 | A, Y |
| ..... | Bu. 4968 Br. | 9 6.9 | +47 24 | 7.8† | 0.038 | F7 | F6 | 3.3 | 0.013 | | |
| 2469 | Bu. 4972[1] | 9 7.6 | +53 7 | 7.9 | 1.677 | K8 | K7 | 8.7 | 0.145 | 0.152 | Ye, F, Ab, *et al.* |
| 2470 | Bu. 4972[2] | 9 7.6 | +53 7 | 8.0 | 1.686 | K6 | K5 | 8.6 | 0.132 | | |
| 2478 | ..... | 9 9.1 | +35 3 | 6.0 | 0.149 | G1 | G1 | 1.5 | 0.013 | | |
| 2490 | 23 Hydrae | 9 11.7 | − 5 56 | 5.4 | 0.004 | K2 | K0 | 0.2 | 0.009 | | |
| C1096 | Bu. 5005 | 9 12.0 | +29 0 | 7.9† | 0.517 | K3 | K3 | 6.5 | 0.052 | 0.067 | S, Y, F |
| 2501 | 83 Cancri | 9 13.4 | +18 8 | 6.6 | 0.180 | F6 | F7 | 3.5 | 0.024 | | |
| 2507 | α Lyncis | 9 15.0 | +34 49 | 3.3 | 0.216 | K5 | K2 | 0.6 | 0.029 | −0.057 | Jo |
| 2516 | θ Pyxidis | 9 17.1 | −25 32 | 4.9 | 0.022 | Ma | G9 | 0.8 | 0.015 | | |
| 2524 | κ Leonis | 9 18.8 | +26 37 | 4.6 | 0.061 | K2 | K0 | 1.3 | 0.022 | −0.004 | A |
| ..... | A.G. Leiden 3861 | 9 19.7 | +33 12 | 7.9 | 0.037‡ | G9 | G7 | 2.3 | 0.008 | | |
| 2528 | ..... | 9 20.0 | +17 1 | 6.3 | 0.079 | K0 | G8 | 2.2 | 0.015 | 0.015 | W |
| 2529 | 28 Hydrae | 9 20.4 | − 4 41 | 5.8 | 0.023 | K4 | G9 | 0.6 | 0.009 | | |
| 2533 | α Hydrae | 9 22.7 | − 8 14 | 2.2 | 0.035 | K5 | K0 | 0.1 | 0.038 | 0.004 | Y, F |

TABLE VII—*Continued*

| Boss | Name | α 1900 | δ 1900 | Harv. Vis. Mag. | μ | Spectrum | | Spect. Abs. Mag. | Spect. π | Trig. π | Auth. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Est. | Meas. | | | | |
| 2536 | 1 H Draco | $9^h22^m9$ | +81°46′ | 4.6 | 0″.027 | K4 | K1 | 0.5 | 0″.015 | | |
| 2540 | 23 Urs. Maj | 9 23.7 | +63 30 | 3.8 | 0.117 | A6 | ..... | 1.3 | 0.032 | | |
| C1126 | Lal. 18672 | 9 24.7 | + 6 5 | 7.6 | 0.533 | K4 | K2 | 6.6 | 0.063 | | |
| 2549 | 24 Urs. Maj | 9 25.6 | +70 16 | 4.6 | 0.090 | G3 | G2 | 2.0 | 0.030 | 0″.048 | Y |
| 2550 | λ Leonis | 9 26.0 | +23 25 | 4.5 | 0.056 | K6 | K2 | 0.5 | 0.016 | 0.039 | M |
| 2552 | θ Urs. Maj | 9 26.2 | +52 8 | 3.3 | 1.092 | F5 | F6 | 3.0 | 0.087 | 0.073 | A, M, Ab, *et al.* |
| 2555 | ξ Leonis | 9 26.6 | +11 45 | 5.1 | 0.130 | G9 | G7 | −0.1 | 0.009 | | |
| 2556 | 6 Leonis | 9 26.6 | +10 9 | 5.3 | 0.024 | K3 | K0 | 0.5 | 0.011 | | |
| C1131 | Lal. 18721 | 9 26.9 | +27 26 | 7.1 | 0.279 | G8 | G8 | 5.2 | 0.042 | 0.055 | A |
| ..... | S Antliae* | 9 27.9 | −28 11 | 6.5 | ..... | A8p | ..... | 0.7 | 0.007 | | |
| 2566 | 10 Leo. Min | 9 28.1 | +36 50 | 4.6 | 0.020 | G4 | G4 | 0.7 | 0.016 | | |
| 2573 | 11 Leo. Min | 9 29.7 | +36 16 | 5.5 | 0.753 | K1 | G6 | 5.4 | 0.096 | 0.140 | A, S, Y, Jo |
| 2580 | 8 Leonis | 9 31.5 | +16 53 | 5.9 | 0.021 | K1 | G7 | 0.6 | 0.009 | | |
| C1143 | A.Oe. 10038 | 9 31.5 | +72 12 | 7.8 | 0.26 | F6 | F6 | 3.9 | 0.017 | −0.002 | G |
| 2589 | 2 Sextantis | 9 33.2 | + 5 6 | 4.8 | 0.176 | K2 | G9 | 1.5 | 0.022 | | |
| 2595 | ι Hydrae | 9 34.7 | − 0 41 | 4.1 | 0.085 | K3 | K1 | 0.8 | 0.022 | | |
| 2602 | o Leonis § | 9 35.8 | +10 21 | 3.8 | 0.150 | F5p | F6 | −1.4 | 0.009 | 0.032 | A, M |
| 2603 | 13 Leonis | 9 35.9 | +26 22 | 6.4 | 0.049 | K2 | G8 | 0.7 | 0.008 | 0.012 | W |
| ..... | W Urs. Maj.* | 9 36.7 | +56 25 | 8.6† | ..... | F8p | ..... | 3.5 | 0.010 | 0.012 | Ye |
| C1153 | Lal. 19022 | 9 37.1 | +43 10 | 8.1 | 0.819 | K5 | K6 | 7.2 | 0.066 | 0.086 | Ye, K, F |
| 2609 | ..... | 9 37.7 | −23 28 | 5.0 | 0.474 | F8 | F7 | 4.2 | 0.069 | | |
| 2612 | ψ Leonis | 9 38.3 | +14 29 | 5.6 | 0.014 | Ma | G7 | 0.6 | 0.010 | | |
| 2614 | ..... | 9 39.4 | +57 35 | 5.4 | 0.025 | Mb | G6 | 0.2 | 0.009 | | |
| 2618 | ε Leonis | 9 40.2 | +24 14 | 3.1 | 0.048 | Go | Go | −0.9 | 0.016 | | |
| 2621 | ..... | 9 40.9 | + 7 10 | 6.0 | 0.040 | Ma | G8 | 0.9 | 0.009 | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2622..... | 18 Leonis..... | $9^h41^m0$ | +12° 16′ | 5.9 | 0″.016 | K5 | G9 | 0.6 | 0″.008 | | |
| 2632..... | υ Urs. Maj..... | 9 43.9 | +59 31 | 3.9 | 0.330 | A8 | A8 | 1.5 | 0.033 | | |
| 2639..... | 23 Leonis..... | 9 45.6 | +13 32 | 6.7 | 0.037 | K7 | Ko | 0.2 | 0.005 | | |
| 2648..... | μ Leonis..... | 9 47.1 | +26 29 | 4.1 | 0.227 | K3 | K2 | 0.6 | 0.020 | 0″.025 | A |
| 2656..... | ..... | 9 49.5 | +73 21 | 6.0 | 0.079 | K2 | K1 | 0.4 | 0.008 | 0.001 | Ab |
| 2660..... | ..... | 9 50.3 | +57 54 | 6.0 | 0.068 | G4 | G4 | 0.3 | 0.008 | 0.006 | W |
| 2663..... | ..... | 9 51.1 | + 9 24 | 5.9 | 0.090 | K1 | G9 | 0.3 | 0.008 | 0.010 | W |
| 2671..... | ..... | 9 52.8 | + 8 47 | 6.3 | 0.035 | K4 | K1 | 0.6 | 0.007 | | |
| 2680..... | π Leonis..... | 9 54.9 | + 8 31 | 4.9 | 0.043 | Ma | K1 | −0.9 | 0.007 | | |
| C1189..... | Groom. 1596..... | 9 54.9 | +56 5 | 8.3 | 0.498 | G7 | G5 | 5.7 | 0.030 | 0.069 | Y |
| 2681..... | 20 Leo. Min..... | 9 55.2 | +32 25 | 5.6 | 0.681 | G7 | G3 | 5.3 | 0.087 | 0.064 | A, K, Jo, F |
| C1192..... | A.Oe. 10427..... | 9 56.1 | +71 21 | 8.3 | 0.24 | G1 | G2 | 3.9 | 0.013 | 0.027 | G |
| C1197..... | Groom. 1603..... | 9 57.9 | +38 30 | 6.8 | 0.170 | F6 | F7 | 3.7 | 0.024 | 0.032 | A |
| 2696..... | 31 Leonis ..... | 10 2.6 | +10 29 | 4.6 | 0.117 | K5 | K3 | 0.4 | 0.014 | | |
| ..... | Comp. α Leonis..... | 10 2.9 | +12 29 | 7.6 | 0.247 | K2 | Ko | 6.2 | 0.052 | 0.033 | Y |
| C1211..... | Lal. 19780..... | 10 3.6 | −19 15 | 7.2 | 0.355 | G2 | Go | 5.1 | 0.038 | 0.057 | F |
| 2701..... | ..... | 10 5.0 | +41 9 | 6.5 | 0.017 | K2 | G8 | 0.6 | 0.007 | | |
| C1218..... | Groom. 1618..... | 10 5.3 | +49 58 | 6.8 | 1.451 | K6 | K6 | 8.3 | 0.200 | 0.177 | K, F, P |
| 2706..... | λ Hydrae..... | 10 5.7 | −11 52 | 3.8 | 0.221 | Ko | G9 | −0.7 | 0.013 | | |
| C1222..... | Lal. 19821..... | 10 6.3 | +24 15 | 8.6 | 0.414 | G4 | G2 | 5.7 | 0.026 | 0.049 | Y |
| C1225..... | A.Oe. 10640..... | 10 7.5 | +53 1 | 9.2 | 0.74 | K3 | K3 | 7.0 | 0.036 | 0.073 | Ye |
| ..... | A.Oe. 10642..... | 10 7.5 | +50 48 | 9.0 | ..... | G6 | G4 | 1.0 | 0.003 | | |
| C1229..... | Lal. 19896..... | 10 8.9 | + 3 39 | 7.7 | 0.464 | G1 | Go | 4.5 | 0.023 | −0.048 | Y |
| 2728..... | 35 Leonis..... | 10 11.0 | +24 0 | 5.9 | 0.209 | G1 | G1 | 3.3 | 0.030 | 0.026 | A, M |
| 2730..... | ζ Leonis..... | 10 11.1 | +23 55 | 3.6 | 0.027 | Fo | F3 | −0.1 | 0.018 | 0.010 | M |
| 2734..... | 39 Leonis..... | 10 11.7 | +23 36 | 5.8 | 0.423 | F8 | F7 | 3.7 | 0.038 | 0.092 | Y |
| 2740..... | ..... | 10 14.1 | +54 43 | 6.2 | 0.023 | Ko | G9 | 1.3 | 0.010 | | |
| C1244..... | W.B. $10^h234$..... | 10 14.2 | +20 22 | 9.2 | 0.490 | Mdp | ..... | 10.5 | 0.182 | 0.196 | D |
| 2741..... | 40 Leonis..... | 10 14.3 | +19 59 | 5.0 | 0.329 | F5 | F5 | 3.2 | 0.044 | 0.052 | M |
| 2742..... | γ Leonis Br..... | 10 14.5 | +20 21 | 2.6 | 0.338 | G8 | G8 | 0.8 | 0.044 | 0.000 | M, Y, F |
| 2743..... | γ Leonis Ft..... | 10 14.5 | +20 21 | 3.8 | 0.353 | G5 | G5 | −0.2 | 0.016 | | |

TABLE VII—*Continued*

| Boss | Name | α 1900 | δ 1900 | Harv. Vis. Mag. | μ | Spectrum | | Spect. Abs. Mag. | Spect. π | Trig. π | Auth. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Est. | Meas. | | | | |
| C1246 | Mün. 5178 | $10^h15^m7$ | − 0°58′ | 8.9 | 0″679 | K5 | K3 | 7.4 | 0″050 | | |
| 2750 | | 10 16.2 | +41 44 | 5.9 | 0.194 | F9 | F8 | 3.5 | 0.033 | 0″090 | M, Jo |
| 2751 | μ Urs. Maj. | 10 16.4 | +42 0 | 3.2 | 0.084 | K5 | G8 | 0.7 | 0.032 | 0.051 | Y |
| 2757 | 43 Leonis | 10 17.8 | + 7 3 | 6.3 | 0.108 | K2 | Ko | 0.7 | 0.008 | | |
| 2762 | 30 H Camelop. | 10 18.9 | +83 4 | 5.3 | 0.084 | Fo | F3 | 2.3 | 0.025 | | |
| 2771 | μ Hydrae | 10 21.3 | −16 20 | 4.1 | 0.153 | K5 | K2 | 0.8 | 0.022 | | |
| 2775 | | 10 21.9 | +49 19 | 6.5 | 0.898 | G2 | G1 | 5.6 | 0.066 | 0.078 | K, R, F |
| 2776 | β Leo. Min. | 10 22.1 | +37 13 | 4.4 | 0.161 | G6 | G7 | 1.2 | 0.023 | 0.013 | M, Ab |
| 2780 | 35 Urs. Maj. | 10 22.8 | +66 8 | 6.4 | 0.045 | K2 | K1 | 1.0 | 0.008 | | |
| C1264 | W.B. $10^h$366 | 10 23.2 | − 6 5 | 8.1 | 0.478 | G9 | G8 | 5.2 | 0.026 | | |
| 2785 | 36 Urs. Maj. | 10 24.2 | +56 30 | 4.8 | 0.182 | F8 | F7 | 3.6 | 0.058 | 0.091 | A, S |
| 2795 | | 10 25.7 | +81 1 | 6.6 | 0.016 | G6 | G7 | 0.2 | 0.005 | | |
| 2799 | 9 H Draco | 10 26.6 | +76 14 | 5.0 | 0.030 | G7 | G7 | 0.2 | 0.011 | | |
| 2800 | 46 Leonis | 10 26.9 | +14 39 | 5.7 | 0.041 | Ma | G7 | 1.0 | 0.012 | 0.005 | W |
| 2806 | | 10 27.7 | +49 42 | 7.6 | 0.292 | F8 | F6 | 4.3 | 0.022 | 0.045 | K |
| 2822 | | 10 31.6 | −11 42 | 5.8 | 0.734 | F7 | F6 | 3.9 | 0.042 | 0.007 | Y, F |
| 2830 | p Velorum* | 10 33.1 | −47 42 | 5.1† | 0.167 | Fop | ..... | 2.2 | 0.026 | | |
| 2831 | 38 Leo. Min. | 10 33.4 | +38 26 | 5.8 | 0.227 | F9 | F8 | 2.2 | 0.019 | 0.029 | Ab |
| 2836 | φ Hydrae | 10 33.7 | −16 21 | 5.1 | 0.111 | G7 | G5 | 1.0 | 0.015 | | |
| 2844 | 35 H Urs. Maj. | 10 35.9 | +69 36 | 5.2 | 0.023 | K4 | G9 | 0.7 | 0.013 | | |
| 2846 | 33 Sextantis | 10 36.3 | − 1 13 | 6.4 | 0.191 | Ko | G8 | 3.5 | 0.026 | | |
| | A.G. Albany 4102 | 10 37.2 | + 1 23 | 7.6 | 0.008‡ | Ko | G8 | 1.9 | 0.007 | | |
| 2853 | | 10 37.7 | +46 44 | 5.3 | 0.289 | A9 | A9 | 1.6 | 0.018 | 0.031 | Jo |
| 2857 | | 10 38.1 | +46 44 | 8.1 | 0.280 | F9 | F9 | 4.4 | 0.018 | −0.004 | K |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ..... | A.G. Leiden 4263..... | $10^h38^m8$ | +33° 9′ | 7.6 | 0″.033‡ | A9 | ..... | 2.5: | 0″.010 | | |
| 2865..... | 41 Urs. Maj..... | 10 40.1 | +57 54 | 6.5 | 0.081 | Ma | K1 | 1.0 | 0.008 | | |
| 2868..... | 37 Sextantis..... | 10 40.9 | + 6 54 | 6.3 | 0.039 | K1 | K0 | 0.8 | 0.008 | | |
| 2881..... | 43 Leo. Min..... | 10 43.4 | +29 57 | 6.3 | 0.103 | G9 | G9 | 1.3 | 0.010 | 0″.036 | W |
| 2888..... | $\nu$ Hydrae..... | 10 44.7 | −15 40 | 3.3 | 0.214 | K1 | K0 | 1.0 | 0.035 | | |
| C1307..... | Lal. 20881..... | 10 46.1 | +20 49 | 8.1 | 0.502 | F1 | F0 | 3.6 | 0.013 | 0.007 | Y |
| 2897..... | ..... | 10 46.7 | +70 23 | 6.1 | 0.403 | K0 | K1 | 4.3 | 0.044 | −0.011 | Y |
| ..... | A.G. Leiden 4299..... | 10 47.1 | +33 31 | 7.6 | 0.049‡ | G9 | G8 | 2.3 | 0.009 | | |
| 2899..... | 46 Leo. Min..... | 10 47.7 | +34 45 | 3.9 | 0.304 | K1 | G9 | 1.4 | 0.032 | 0.058 | M, Ab |
| 2910..... | ..... | 10 50.2 | +34 2 | 5.2 | 0.113 | K1 | G9 | 0.7 | 0.013 | 0.014 | Ab |
| 2912..... | ..... | 10 50.5 | +42 33 | 6.1 | 0.101 | K1 | G9 | 3.0 | 0.024 | | |
| 2915..... | 56 Leonis..... | 10 50.8 | + 6 43 | 6.0 | 0.023 | Mc | G5 | −0.6 | 0.005 | −0.004 | W |
| C1325..... | Lal. 21008..... | 10 50.9 | +28 17 | 8.6 | 0.472 | G6 | G5 | 5.2 | 0.021 | 0.050 | Y |
| 2918..... | ..... | 10 52.0 | +78 18 | 6.3 | 0.081 | G7 | G7 | 0.5 | 0.007 | | |
| 2920..... | 47 Urs. Maj..... | 10 53.9 | +40 58 | 5.1 | 0.320 | G2 | G1 | 4.1 | 0.063 | 0.080 | A |
| 2921..... | ..... | 10 54.0 | +36 38 | 6.2 | 0.095 | Ma | G8 | 1.0 | 0.009 | | |
| 2922..... | ..... | 10 54.5 | +46 4 | 5.7 | 0.016 | K5 | K0 | 0.5 | 0.009 | | |
| 2925..... | $\alpha$ Crateris..... | 10 54.9 | −17 46 | 4.2 | 0.481 | K0 | G9 | −0.1 | 0.014 | | |
| 2927..... | 58 Leonis..... | 10 55.4 | + 4 9 | 5.0 | 0.023 | K1 | G9 | 0.5 | 0.013 | | |
| 2931..... | 61 Leonis..... | 10 56.7 | − 1 57 | 5.0 | 0.041 | K6 | K1 | 0.3 | 0.012 | | |
| 2933..... | $\alpha$ Urs. Maj..... | 10 57.6 | +62 17 | 2.0 | 0.139 | G8 | G8 | 0.4 | 0.048 | 0.037 | F |
| 2935..... | 22 H Camelop..... | 10 57.9 | +36 38 | 7.6 | 4.779 | Ma | ..... | 10.5 | 0.380 | 0.411 | Ye, S, Y, *et al.* |
| 2938..... | 62 Leonis..... | 10 58.5 | + 0 32 | 6.2 | 0.066 | K3 | K2 | 0.6 | 0.008 | | |
| 2942..... | $\chi$ Leonis..... | 10 59.9 | + 7 53 | 4.7 | 0.350 | F5 | F4 | 0.8 | 0.017 | 0.012 | M |
| 2943..... | 51 Leo. Min..... | 10 59.9 | +25 45 | 7.5 | 0.409 | F7 | F7 | 4.7 | 0.028 | 0.039 | Y |
| C1349..... | Lal. 21258..... | 11 0.5 | +44 2 | 8.9 | 4.519 | Ma | ..... | 10.1 | 0.174 | 0.190 | M, R, K, *et al.* |
| 2950..... | 65 Leonis..... | 11 1.8 | + 2 30 | 5.7 | 0.386 | G9 | G7 | 2.6 | 0.024 | | |
| 2958..... | $\psi$ Urs. Maj..... | 11 4.0 | +45 2 | 3.2 | 0.069 | K0 | G9 | 1.3 | 0.042 | | |
| ..... | Bu. 5695 B..... | 11 5.5 | +31 0 | 9.8 | 0.623 | Ma | ..... | 8.8 | 0.063) | 0.048 | Y |
| C1361..... | Bu. 5695 A..... | 11 5.6 | +31 0 | 8.8 | 0.623 | K7 | K3 | 8.4 | 0.083) | | |

TABLE VII—*Continued*

| Boss | Name | α 1900 | δ 1900 | Harv. Vis. Mag. | μ | Spectrum | | Spect. Abs. Mag. | Spect. π | Trig. π | Auth. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Est. | Meas. | | | | |
| 2984 | Bu. 5695 C | 11h 5m6 | +31° 2′ | 9.0 | ..... | G6 | G6 | 3.8 | 0″.009 | | |
| 2971 | Bu. 5706 A | 11 8.6 | +74 1 | 7.8† | 0″.405 | K5 | K4 | 7.2 | 0.076 | 0″.088 | F, Bgs |
| 2976 | 72 Leonis | 11 9.9 | +23 38 | 4.9 | 0.018 | Ma | G5 | −0.5 | 0.008 | | |
| 2978 | 73 Leonis | 11 10.6 | +13 51 | 5.5 | 0.028 | K2 | K1 | 1.0 | 0.013 | | |
| 2980 | ..... | 11 11.1 | +50 1 | 6.0 | 0.092 | G6 | G9 | 1.4 | 0.012 | −0.081 | Y |
| 2983 | 75 Leonis | 11 12.1 | + 2 34 | 5.4 | 0.159 | Ma | K2 | 0.7 | 0.012 | | |
| 2984 | ξ Urs. Maj. Br. | 11 12.9 | +32 6 | 4.4 | 0.732 | F9 | F9 | 4.9 | 0.126 | 0.158 | Y, Ab, F |
| 2984 | ξ Urs. Maj. Ft. | 11 12.9 | +32 6 | 4.9 | 0.732 | G2 | G2 | 5.3 | 0.120 | | |
| 2985 | ν Urs. Maj. | 11 13.1 | +33 38 | 3.7 | 0.027 | K4 | G9 | 0.4 | 0.022 | | |
| 2986 | ..... | 11 13.2 | − 4 31 | 7.3 | 0.808 | G8 | G6 | 6.1 | 0.058 | 0.034 | M, Y |
| 2989 | δ Crateris | 11 14.3 | −14 14 | 3.8 | 0.230 | G9 | G7 | 0.7 | 0.024 | | |
| C1383 | A.Oe. 11677 | 11 14.8 | +66 23 | 9.2 | 2.986 | Ma | ..... | 10.9 | 0.219 | 0.198 | F, Bgs |
| 2995 | 56 Urs. Maj. | 11 17.3 | +44 2 | 5.1 | 0.038 | G6 | G7 | −0.1 | 0.009 | | |
| 2997 | λ Crateris | 11 18.4 | −18 14 | 5.2 | 0.314 | F3 | F4 | 1.2 | 0.016 | | |
| 2999 | ι Leonis Br. | 11 18.7 | +11 5 | 4.0 | 0.176 | F4 | F4 | 2.8 | 0.058 | | |
| 3014 | 83 Leonis Br. | 11 21.7 | + 3 33 | 6.5 | 0.743 | G9 | G7 | 5.3 | 0.058 | 0.023 | Y, R |
| 3015 | 83 Leonis Ft. | 11 21.7 | + 3 33 | 7.6 | 0.736 | K4 | K5 | 6.4 | 0.058 | | |
| 3021 | τ Leonis | 11 22.8 | + 3 24 | 5.2 | 0.028 | G7 | G6 | 0.1 | 0.010 | | |
| 3022 | ..... | 11 23.4 | +62 19 | 5.9 | 0.267 | F3 | F3 | 3.1 | 0.028 | | |
| 3025 | 85 Leonis | 11 24.5 | +15 58 | 6.0 | 0.066 | K3 | K2 | 1.1 | 0.011 | | |
| 3029 | 87 Leonis | 11 25.2 | − 2 27 | 5.1 | 0.026 | K4 | G9 | 1.1 | 0.016 | | |
| 3030 | 86 Leonis | 11 25.3 | +18 58 | 5.7 | 0.078 | K0 | G8 | 1.1 | 0.012 | 0.009 | W |
| ..... | Bu. 5805 | 11 25.4 | +41 51 | 7.6† | 0.130‡ | F2 | F4 | 2.9 | 0.012 | | |
| 3031 | λ Draconis | 11 25.5 | +69 53 | 4.1 | 0.045 | K5 | K0 | 0.2 | 0.017 | 0.018 | M |
| 3032 | 88 Leonis Br. | 11 26.6 | +14 55 | 6.3† | 0.387 | F9 | F9 | 3.6 | 0.029 | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3033 | Bu. 5811 | 11h26m7 | +61°38′ | 5.8† | 0.″079 | F4 | F6 | 4.0 | 0.″044 | 0.″057 | S |
| C1426 | Lal. 21927 | 11 28.4 | +65 48 | 7.2 | 0.204 | F5 | F7 | 3.7 | 0.020 | 0.027 | G |
| 3047 | | 11 29.6 | −32 18 | 6.1 | 1.058 | K2 | K0 | 6.2 | 0.105 | 0.235 | F |
| 3050 | 2 Draconis | 11 30.2 | +69 53 | 5.4 | 0.176 | G5 | G7 | −0.4 | 0.007 | | |
| 3058 | υ Leonis | 11 31.8 | − 0 16 | 4.5 | 0.035 | G8 | G7 | 1.0 | 0.020 | | |
| | SU Draconis § | 11 32.2 | +67 53 | 9.2 | | A5 | | 0.9: | 0.002 | | |
| 3069 | Bu. 5858 Br | 11 33.5 | +45 40 | 6.3 | 0.583 | F8 | F9 | 4.1 | 0.036 | 0.038 | K |
| 3069 | Bu. 5858 Ft | 11 33.5 | +45 40 | 8.6 | 0.583 | K4 | K2 | 6.7 | 0.042 | | |
| 3075 | 61 Urs. Maj | 11 35.8 | +34 46 | 5.5 | 0.390 | G5 | G4 | 4.8 | 0.072 | | |
| 3078 | 62 Urs. Maj | 11 36.4 | +32 18 | 5.7 | 0.347 | F2 | F4 | 3.8 | 0.042 | 0.042 | W |
| 3081 | 3 Draconis | 11 36.9 | +67 18 | 5.5 | 0.058 | K2 | K0 | 0.6 | 0.010 | | |
| 3087 | ζ Crateris | 11 39.7 | −17 48 | 4.9 | 0.052 | G7 | G5 | 1.1 | 0.017 | | |
| C1452 | Groom. 1822 | 11 40.3 | +48 14 | 8.0 | 0.644 | F9 | G0 | 4.1 | 0.017 | 0.024 | K |
| 3089 | ν Virginis | 11 40.7 | + 7 5 | 4.2 | 0.188 | Ma | G6 | 0.2 | 0.016 | | |
| 3090 | χ Urs. Maj | 11 40.8 | +48 20 | 3.8 | 0.137 | K0 | G8 | 1.3 | 0.032 | | |
| 3098 | 93 Leonis | 11 42.8 | +20 46 | 4.5 | 0.155 | F4 | F7 | 3.1 | 0.052 | 0.029 | M |
| 3100 | | 11 43.7 | −26 12 | 5.4 | 0.028 | Mc | G7 | 0.2 | 0.009 | | |
| 3105 | β Virginis | 11 45.5 | + 2 20 | 3.8 | 0.793 | F7 | F7 | 3.5 | 0.087 | 0.104 | A, M, Y |
| 3112 | Groom. 1830 | 11 47.2 | +38 26 | 6.5 | 7.047 | G8 | G5 | 6.0 | 0.079 | 0.106 | M, Y, K, *et al.* |
| | A.G. Leip. 4431 | 11 48.7 | +14 35 | 8.1 | 0.032‡ | F1 | | 2.7 | 0.008 | | |
| C1475 | Bu. 5960 S | 11 49.4 | +19 58 | 8.4 | 0.445 | G4 | G5 | 5.9 | 0.032 | | |
| C1476 | Bu. 5960 N | 11 49.5 | +19 59 | 8.4 | 0.436 | G6 | G6 | 5.3 | 0.024 | | |
| 3125 | 66 Urs. Maj | 11 50.8 | +57 9 | 5.9 | 0.012 | K1 | G9 | 0.4 | 0.008 | | |
| C1487 | Lac. 4055 | 11 53.0 | −27 8 | 7.2 | 1.243 | K5 | K3 | 7.0 | 0.091 | 0.039 | F |
| 3137 | | 11 55.6 | − 9 53 | 5.6 | 0.491 | G9 | G7 | 4.8 | 0.069 | 0.101 | Y, M |
| 3141 | | 11 56.5 | +36 36 | 5.6 | 0.136 | G9 | G8 | 0.9 | 0.012 | 0.036 | W |
| 3145 | | 11 57.4 | +43 39 | 6.8 | 0.629 | G7 | G5 | 3.6 | 0.023 | 0.017 | K, F |
| 3155 | ο Virginis | 12 0.1 | + 9 17 | 4.2 | 0.221 | G6 | G6 | 0.4 | 0.017 | 0.039 | A |
| C1497 | Lal. 22701 | 12 0.1 | − 0 57 | 8.4 | 0.531 | G8 | G6 | 6.4 | 0.040 | 0.110 | Y |
| 3157 | | 12 0.6 | +63 30 | 6.2 | 0.087 | K1 | K1 | 2.0 | 0.014 | | |

TABLE VII—*Continued*

| Boss | Name | α 1900 | δ 1900 | Harv. Vis. Mag. | μ | Spectrum | | Spect. Abs. Mag. | Spect. π | Trig. π | Auth. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Est. | Meas. | | | | |
| 3166 | α Corvi | 12h 3m3 | −24° 10′ | 4.2 | 0″.093 | F1 | F1 | 2.8 | 0″.052 | | |
| C1511 | Groom. 1855 | 12 4.6 | +40 49 | 7.4 | 0.325 | K0 | G6 | 5.7 | 0.046 | 0″.064 | K |
| 3169 | 10 Virginis | 12 4.6 | + 2 28 | 6.1 | 0.190 | K2 | K1 | 1.6 | 0.013 | 0.028 | W |
| 3172 | ε Corvi | 12 5.0 | −22 4 | 3.2 | 0.065 | K3 | K1 | 0.5 | 0.029 | 0.026 | M |
| 3177 | | 12 6.5 | +82 16 | 6.3 | 0.019 | K3 | G9 | 0.8 | 0.008 | | |
| 3179 | 68 Urs. Maj | 12 6.8 | +57 37 | 6.5 | 0.020 | K4 | K0 | 0.8 | 0.007 | | |
| C1522 | W.B. 12h69 | 12 7.4 | − 2 32 | 7.4 | 0.732 | G6 | G2 | 5.0 | 0.033 | 0.011 | Y, F |
| C1523 | Lal. 22901 | 12 7.8 | +10 36 | 8.0 | 0.430 | K0 | G9 | 5.1 | 0.026 | | |
| C1524 | Lal. 22908 | 12 8.1 | +11 24 | 7.9 | 0.589 | G4 | G2 | 5.5 | 0.033 | 0.049 | A, Y |
| 3186 | 1 Can. Ven | 12 9.8 | +53 59 | 6.3 | 0.023 | G9 | G7 | 0.5 | 0.007 | | |
| C1533 | Lal. 22954 | 12 10.0 | − 9 44 | 6.1 | 1.024 | F3 | F6 | 3.7 | 0.033 | 0.026 | Y, F |
| 3193 | 2 Can. Ven | 12 11.1 | +41 13 | 5.8 | 0.051 | K6 | K2 | 0.6 | 0.009 | | |
| 3194 | 7 Comae | 12 11.3 | +24 30 | 5.1 | 0.028 | G8 | G7 | 1.3 | 0.017 | | |
| | SW Draconis § | 12 12.8 | +70 4 | 10.0 | ..... | F4 | ..... | 0.6: | 0.001 | | |
| | A.G. Berlin 4636 | 12 13.0 | +19 0 | 7.5 | 0.026 | F6 | F6 | 2.6 | 0.011 | | |
| C1542 | Pi. 12h40 | 12 14.1 | +17 6 | 7.0 | 0.237 | G2 | G2 | 4.4 | 0.030 | 0.024 | A |
| 3208 | 6 B Urs. Min | 12 14.4 | +88 15 | 6.3 | 0.067 | F0 | ..... | 2.0 | 0.014 | | |
| 3209 | 9 Comae | 12 14.5 | +28 43 | 6.3 | 0.245 | F8 | F7 | 3.4 | 0.026 | 0.054 | S |
| 3213 | 16 Virginis | 12 15.3 | + 3 52 | 5.1 | 0.307 | K0 | G7 | 1.6 | 0.020 | −0.006 | A |
| 3216 | 11 Comae | 12 15.7 | +18 21 | 4.9 | 0.139 | G6 | G6 | 0.7 | 0.014 | | |
| 3217 | | 12 15.8 | −13 1 | 5.4 | 0.002 | K1 | G9 | 1.3 | 0.015 | | |
| C1551 | W.B. 12h309 | 12 16.9 | +42 42 | 9.1 | 0.57 | Ma | ..... | 8.5 | 0.076 | | |
| C1557 | A.Oe. 12584 | 12 17.9 | +73 48 | 8.2 | 0.49 | G6 | G6 | 5.4 | 0.028 | | |
| 3230 | 5 Can. Ven | 12 19.2 | +52 7 | 5.0 | 0.011 | G6 | G5 | 0.1 | 0.011 | | |
| | Bu. 6158 | 12 19.4 | +26 9 | 6.6† | ..... | A8 | ..... | 2.1 | 0.013 | −0.022 | S |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C1563 | Lal. 23223 | 12h19m9 | − 3° 40′ | 8.0 | 0″.258 | G2 | G2 | 5.4 | 0″.030 | 0″.055 | Ye |
| C1564 | Lal. 23231 | 12 19.9 | +38 52 | 8.1 | 0.62 | F6 | F7 | 4.3 | 0.017 | | |
| 3233 | | 12 20.2 | +24 29 | 6.1 | 0.072 | G9 | G9 | 0.6 | 0.008 | 0.005 | W |
| 3234 | 71 Urs. Maj. | 12 20.3 | +57 20 | 6.0 | 0.028 | Mb | G8 | 0.5 | 0.008 | | |
| 3242 | γ Comae | 12 22.0 | +28 49 | 4.6 | 0.122 | K2 | K1 | 0.7 | 0.017 | 0.002 | A |
| 3248 | 73 Urs. Maj. | 12 22.8 | +56 16 | 5.8 | 0.031 | Ma | Ko | 0.5 | 0.009 | | |
| 3254 | 18 Comae | 12 24.4 | +24 40 | 5.5 | 0.025 | F2 | F3 | 0.9 | 0.012 | | |
| C1579 | Lal. 23361 | 12 24.6 | − 2 46 | 8.6 | 0.721 | G3 | G3 | 6.1 | 0.032 | 0.095 | Y |
| 3258 | | 12 24.9 | −12 50 | 6.4 | 0.251 | Go | F9 | 3.9 | 0.032 | | |
| 3261 | 7 Can. Ven. | 12 25.3 | +52 5 | 6.2 | 0.275 | F6 | F6 | 3.0 | 0.023 | | |
| 3265 | 4 Draconis | 12 25.7 | +69 45 | 5.2 | 0.084 | Mb | G7 | −0.8 | 0.006 | | |
| | A.G. Berlin 4695 | 12 26.1 | +17 10 | 7.5 | 0.025‡ | K1 | Ko | 2.0 | 0.008 | | |
| 3272 | η Corvi | 12 26.9 | −15 39 | 4.4 | 0.444 | F2 | | 2.5 | 0.042 | | |
| 3274 | 20 Virginis | 12 28.0 | +10 51 | 6.5 | 0.063 | G8 | G8 | 0.4 | 0.006 | | |
| 3279 | β Can. Ven. | 12 29.0 | +41 54 | 4.3 | 0.758 | Go | Go | 4.4 | 0.105 | 0.107 | A, M, Y, F |
| 3280 | β Corvi | 12 29.1 | −22 51 | 2.8 | 0.061 | G5 | G4 | 0.0 | 0.028 | | |
| 3285 | 24² Comae | 12 30.1 | +18 56 | 5.2 | 0.016 | K1 | Ko | 0.3 | 0.011 | | |
| 3294 | | 12 33.3 | + 2 24 | 6.0 | 0.090 | Mb | G9 | 0.7 | 0.009 | | |
| 3298 | χ Virginis | 12 34.1 | − 7 27 | 4.8 | 0.085 | K3 | K2 | 0.6 | 0.014 | | |
| C1604 | B.D. +69° 671 | 12 36.0 | +69 21 | 8.2 | 0.46 | G1 | G2 | 4.9 | 0.022 | 0.036 | G |
| 3307 | γ Virginis S | 12 36.6 | − 0 54 | 3.7 | 0.564 | Fo | | 2.2 | 0.050 | 0.068 | R, F, Bel |
| 3307 | γ Virginis N | 12 36.6 | − 0 54 | 3.7 | 0.564 | F1 | | 2.4 | 0.055 | | |
| | Groom. 1923 | 12 37.8 | +84 12 | 7.2 | 0.232 | F7 | F9 | 3.2 | 0.016 | 0.000 | G |
| 3321 | 10 Can. Ven. | 12 40.3 | +39 49 | 6.0 | 0.375 | F6 | F8 | 3.9 | 0.038 | 0.063 | A |
| 3326 | 33 Virginis | 12 41.3 | +10 6 | 5.9 | 0.531 | Ko | G9 | 4.2 | 0.046 | −0.008 | S, Y |
| 3327 | 27 Comae | 12 41.7 | +17 7 | 5.3 | 0.008 | K3 | K1 | 0.4 | 0.010 | | |
| 3336 | 7 Draconis | 12 43.5 | +67 20 | 5.7 | 0.008 | K3 | G8 | 0.7: | 0.010 | | |
| C1627 | Lal. 23900 | 12 43.9 | +25 23 | 6.4 | 0.367 | G6 | G5 | 5.3 | 0.060 | 0.026 | A |
| C1630 | Lal. 23917 | 12 44.6 | + 1 45 | 8.1 | 0.665 | G8 | G4 | 6.1 | 0.040 | 0.029 | A, Y |
| 3344 | | 12 46.2 | − 9 48 | 6.5 | 0.021 | G8 | G7 | 0.9 | 0.008 | | |

TABLE VII—*Continued*

| Boss | Name | α 1900 | δ 1900 | Harv. Vis. Mag. | μ | Spectrum | | Spect. Abs. Mag. | Spect. π | Trig. π | Auth. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Est. | Meas. | | | | |
| 3346 | 37 Virginis | $12^h46^m5$ | + 3° 36′ | 6.1 | 0″.035 | K3 | K1 | 0.6 | 0″.008 | | |
| 3347 | 31 Comae | 12 46.8 | +28 5 | 5.1 | 0.031 | F6 | F7 | 2.1 | 0.025 | | |
| 3348 | 32 Comae | 12 47.2 | +17 37 | 6.5 | 0.023 | K4 | G9 | 0.6 | 0.007 | | |
| C1640 | Lal. 23995 | 12 47.9 | −17 57 | 8.3 | 0.877 | F3 | F7 | 3.4 | 0.011 | | |
| 3353 | 38 Virginis | 12 48.1 | − 3 1 | 6.2 | 0.262 | F6 | F6 | 3.3 | 0.026 | | |
| 3362 | ψ Virginis | 12 49.2 | − 9 0 | 4.9 | 0.032 | Ma | G6 | −0.3 | 0.009 | | |
| 3367 | δ Virginis | 12 50.6 | + 3 56 | 3.7 | 0.479 | Mb | G7 | 0.3 | 0.021 | 0″.002 | A, Y |
| C1657 | Lal. 24168 | 12 53.9 | − 9 18 | 7.7 | 0.850 | K2 | K0 | 6.4 | 0.055 | −0.015 | Y |
| 3374 | 36 Comae | 12 54.0 | +17 57 | 5.0 | 0.036 | K6 | K1 | 0.9 | 0.015 | | |
| C1664 | Pi. $12^h243$ | 12 55.7 | +18 55 | 6.1 | 0.245 | F5 | F5 | 3.4 | 0.029 | 0.022 | A |
| C1666 | A.Oe. 12585 | 12 56.1 | −26 50 | 8.2 | 0.545 | F4 | F6 | 3.8 | 0.013 | | |
| C1667 | W.B. $12^h920$ | 12 56.2 | − 7 54 | 8.7 | 0.493 | G6 | G5 | 5.7 | 0.025 | 0.010 | Y |
| 3381 | 38 Comae | 12 56.2 | +17 40 | 6.0 | 0.033 | G8 | G7 | 0.8 | 0.009 | | |
| 3383 | ϵ Virginis | 12 57.2 | +11 30 | 3.0 | 0.273 | G6 | G6 | 0.0 | 0.025 | 0.034 | F |
| 3398 | 40 Comae | 13 1.5 | +23 9 | 5.9 | 0.066 | Mc | G8 | 0.2 | 0.007 | 0.043 | W |
| 3401 | 41 Comae | 13 2.4 | +28 10 | 4.9 | 0.089 | K4 | K2 | 0.4 | 0.013 | | |
| 3402 | ..... | 13 2.4 | +62 35 | 6.3 | 0.045 | G8 | G7 | 2.6 | 0.018 | | |
| C1687 | Lal. 24414 | 13 3.8 | + 5 46 | 6.9 | 0.682 | G4 | G2 | 4.1 | 0.028 | 0.029 | A, Y |
| 3406 | ..... | 13 4.2 | +10 33 | 6.0 | 0.020 | K0 | G8 | 1.2 | 0.011 | | |
| 3408 | 50 Virginis | 13 4.5 | − 9 48 | 6.2 | 0.023 | K4 | K1 | 0.5 | 0.007 | | |
| ..... | B.D. +18° 2696 | 13 4.6 | +18 0 | 8.1 | ..... | K3 | K1 | 1.0 | 0.004 | −0.002 | Ye |
| 3412 | α Comae | 13 5.1 | +18 3 | 5.2† | 0.450 | F4 | F5 | 3.9 | 0.055 | 0.070 | A, Ye, F |
| C1692 | Lal. 24504 | 13 6.4 | +10 9 | 8.5 | 0.559 | G2 | G2 | 4.7 | 0.017 | 0.028 | Y |
| 3422 | 53 Virginis | 13 6.7 | −15 40 | 5.1 | 0.314 | F6 | F6 | 3.2 | 0.042 | | |
| C1693 | A.Oe. 13407 | 13 7.0 | +68 2 | 8.8 | 0.75 | K2 | K0 | 5.6 | 0.023 | 0.010 | G |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3424 | $\beta$ Comae | $13^h\ 7^m.2$ | $+38°\ 23'$ | 4.3 | 1".184 | G1 | G0 | 4.7 | 0".120 | 0".131 | M, Y, F, P |
| C1695 | A.G. Berlin 4855 | 13 7.5 | +18 3 | 7.8 | 0.578 | F6 | F9 | 4.4 | 0.021 | | |
| 3438 | 57 Virginis | 13 10.6 | −19 25 | 5.3 | 0.322 | K1 | K0 | 2.2 | 0.024 | | |
| 3442 | | 13 11.5 | +81 0 | 6.3 | 0.008 | G8 | G7 | 0.3: | 0.006 | | |
| 3443 | 59 Virginis | 13 11.8 | + 9 57 | 5.2 | 0.382 | G0 | F9 | 4.4 | 0.069 | 0.075 | A |
| C1712 | Bu. 6442 Br | 13 11.9 | +17 33 | 6.6† | 0.691 | K3 | K1 | 6.4 | 0.091 | 0.076 | S |
| 3446 | $\sigma$ Virginis | 13 12.6 | + 6 0 | 5.0 | 0.016 | Ma | G6 | 0.3 | 0.012 | | |
| 3447 | 20 Can. Ven | 13 13.1 | +41 6 | 4.7 | 0.125 | F4 | F3 | −1.4 | 0.006 | | |
| 3448 | 61 Virginis | 13 13.2 | −17 45 | 4.8 | 1.529 | G8 | G5 | 4.9 | 0.105 | 0.136 | M, F |
| 3449 | $\gamma$ Hydrae | 13 13.5 | −22 39 | 3.3 | 0.083 | G7 | G5 | 0.3 | 0.025 | −0.012 | M |
| C1719 | W.B. $13^h241$ | 13 14.9 | +35 39 | 9.6 | 0.884 | Ma | K5 | 9.6 | 0.100 | 0.080 | Y |
| C1722 | W.B. $13^h216$ | 13 15.7 | + 4 39 | 8.8 | 0.575 | K3 | K3 | 6.4 | 0.033 | −0.021 | Y |
| C1723 | Lal. 24774 | 13 16.1 | +43 38 | 8.2 | 0.438 | K1 | K0 | 6.1 | 0.038 | 0.179 | Y |
| 3475 | $\zeta^2$ Urs. Maj | 13 19.9 | +55 27 | 4.0 | 0.028 | A7 | ..... | 1.9 | 0.038 | 0.022 | M |
| 3483 | | 13 22.6 | +63 46 | 6.5 | 0.444 | G7 | G5 | 5.1 | 0.052 | | |
| 3485 | | 13 23.2 | − 0 19 | 7.5 | 0.462 | G2 | G2 | 4.2 | 0.022 | | |
| 3487 | 70 Virginis | 13 23.5 | +14 19 | 5.2 | 0.634 | G3 | G4 | 3.9 | 0.055 | 0.065 | A, M, Y |
| 3488 | | 13 23.6 | +72 55 | 6.1 | 0.030 | K4 | G9 | 0.3 | 0.007 | | |
| ..... | Groom. 2004 | 13 24.4 | +70 50 | 7.5 | 0.040 | F1 | ..... | 2.7 | 0.011 | | |
| ..... | Groom. 2005 | 13 25.3 | +70 39 | 7.5 | 0.039 | K0 | G8 | 2.2 | 0.009 | | |
| C1748 | Lal. 25012 | 13 26.6 | − 1 49 | 7.3 | 0.887 | G9 | G7 | 5.9 | 0.052 | 0.053 | Y |
| 3499 | 74 Virginis | 13 26.8 | − 5 44 | 4.8 | 0.112 | Ma | G8 | 0.6 | 0.014 | | |
| 3500 | | 13 26.9 | +42 37 | 6.2 | 0.094 | K1 | K0 | 1.6 | 0.012 | | |
| 3511 | | 13 30.3 | +37 42 | 5.0 | 0.085 | F5 | F5 | 2.4 | 0.030 | | |
| 3526 | Bu. 6578 | 13 34.6 | +11 15 | 6.3† | 0.112 | A9p | ..... | 1.5 | 0.011 | 0.015 | A, Ye, M, *et al.* |
| ..... | B.D. $+76°$ 493 | 13 34.9 | +76 25 | 8.0 | ..... | G4 | G3 | 4.9 | 0.024 | 0.022 | G |
| ..... | Groom. 2026 | 13 35.1 | +48 24 | 7.9 | 0.026 | F3 | ..... | 2.2 | 0.007 | | |
| ..... | A.G. Leiden 4974 | 13 36.0 | +33 21 | 7.8 | 0.059‡ | F8 | F7 | 3.0 | 0.011 | | |
| 3534 | 82 Virginis | 13 36.4 | − 8 12 | 5.2 | 0.108 | Ma | G9 | 0.3 | 0.011 | | |
| 3537 | 84 Virginis | 13 38.0 | + 4 3 | 5.7† | 0.302 | K3 | K1 | 0.4 | 0.009 | | |

TABLE VII—*Continued*

| Boss | Name | α 1900 | δ 1900 | Harv. Vis. Mag. | μ | Spectrum | | Spect. Abs. Mag. | Spect. π | Trig. π | Auth. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Est. | Meas. | | | | |
| 3541 | | $13^h39^m0$ | +23°12′ | 6.4 | 0″.072 | K5 | K2 | 0.7 | 0″.007 | | |
| 3542 | 83 Virginis | 13 39.1 | −15 41 | 5.7 | 0.009 | G3p | F7 | −0.6 | 0.006 | | |
| C1784 | A.G. Berlin 4999 | 13 40.2 | +18 20 | 9.6 | 1.86 | Ma | ..... | 10.1 | 0.126 | 0″.090 | D, Ye, R |
| C1786 | Lal. 25372 | 13 40.7 | +15 26 | 8.5 | 2.298 | Mb | K4 | 10.2 | 0.219 | 0.200 | M, Ye, Y, *et al.* |
| C1789 | Pi. $13^h200$ | 13 41.5 | +56 23 | 6.4 | 0.372 | F6 | F7 | 3.5 | 0.026 | 0.027 | A |
| 3551 | | 13 41.9 | − 9 13 | 6.2 | 0.042 | K4 | K3 | 0.6 | 0.008 | | |
| 3554 | | 13 42.0 | + 6 51 | 6.3 | 0.499 | F9 | G0 | 4.3 | 0.040 | 0.028 | A |
| 3558 | τ Boötis | 13 42.5 | +17 57 | 4.5 | 0.487 | F7 | F6 | 3.0 | 0.050 | 0.046 | A, Y |
| 3571 | 89 Virginis | 13 44.4 | −17 38 | 5.1 | 0.108 | K0 | G9 | 1.1 | 0.016 | | |
| C1800 | Bu. 6641 Br. | 13 44.5 | +27 29 | 7.9 | 0.455 | K6 | K4 | 7.1 | 0.069 | | |
| C1800 | Bu. 6641 Ft. | 13 44.5 | +27 29 | 8.2 | 0.455 | K6 | K4 | 7.4 | 0.069 | | |
| C1804 | Lal. 25484 | 13 45.8 | −23 53 | 6.5 | 0.658 | G2 | G1 | 5.6 | 0.066 | | |
| 3581 | | 13 46.7 | +35 10 | 6.0 | 0.072 | Ma | K0 | 0.7 | 0.009 | 0.012 | W |
| 3584 | | 13 47.4 | +34 56 | 5.0 | 0.044 | Ma | G8 | 0.4 | 0.012 | | |
| 3589 | 10 Draconis | 13 48.5 | +65 13 | 4.8 | 0.004 | Mb | G7 | −0.5 | 0.009 | | |
| 3594 | 90 Virginis | 13 49.6 | − 1 1 | 5.3 | 0.091 | K1 | K0 | 0.4 | 0.011 | | |
| 3595 | Bu. 6668 Br. | 13 49.7 | − 7 34 | 6.5† | 0.167 | F8 | F8 | 4.1 | 0.033 | | |
| 3596 | η Boötis | 13 49.9 | +18 54 | 2.8 | 0.373 | F9 | G0 | 2.8 | 0.100 | | |
| 3605 | | 13 53.8 | +15 8 | 6.0 | 0.087 | K4 | K2 | 0.5 | 0.008 | | |
| 3616 | | 13 59.0 | −14 29 | 6.4 | 0.048 | K1 | K0 | 2.1 | 0.014 | | |
| 3623 | θ Centauri | 14 0.8 | −35 53 | 2.3 | 0.750 | K1 | G8 | 1.0 | 0.055 | −0.062 | F |
| 3629 | 96 Virginis | 14 3.7 | − 9 52 | 6.5 | 0.016 | G8 | G7 | −0.1 | 0.005 | | |
| 3630 | | 14 3.9 | +44 20 | 5.4 | 0.037 | Mb | G6 | −0.8 | 0.006 | | |
| 3631 | 13 Boötis | 14 4.6 | +49 56 | 5.4 | 0.068 | Ma | G6 | −0.2 | 0.008 | | |
| 3635 | 12 Boötis | 14 5.8 | +25 34 | 4.8 | 0.076 | F6 | F7 | 1.9 | 0.026 | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3641 | | $14^h\ 7^m.5$ | $-26°\ 9'$ | 6.3 | 0".004 | G8 | G6 | 0.9 | 0".008 | | |
| 3642 | κ Virginis | 14 7.6 | − 9 49 | 4.3 | 0.130 | K2 | G9 | 1.0 | 0.022 | | |
| 3644 | | 14 8.5 | − 0 22 | 5.8 | 0.241 | F5 | F5 | 2.6 | 0.023 | | |
| 3647 | | 14 9.1 | − 5 29 | 6.3 | 0.317 | F8 | F8 | 3.7 | 0.030 | | |
| 3649 | 4 Urs. Min. | 14 9.2 | +78 1 | 5.0 | 0.038 | K3 | Ko | 0.7 | 0.014 | | |
| 3650 | 14 Boötis | 14 9.3 | +13 26 | 5.5 | 0.267 | F7 | F6 | 4.1 | 0.052 | 0".097 | W |
| 3656 | | 14 10.2 | +69 54 | 5.4 | 0.068 | Ma | K1 | 0.3 | 0.010 | | |
| 3658 | | 14 10.4 | +41 59 | 6.2 | 0.122 | K3 | K2 | 0.7 | 0.008 | 0.025 | W |
| 3660 | ι Virginis | 14 10.8 | − 5 31 | 4.2 | 0.427 | F6 | F6 | 2.4 | 0.044 | | |
| 3662 | α Boötis | 14 11.1 | +19 42 | 0.2 | 2.282 | Ko | G9 | 1.2 | 0.158 | 0.075 | Y, F |
| 3671 | | 14 13.3 | −25 22 | 5.9 | 0.538 | F5 | F7 | 3.7 | 0.036 | | |
| 3673 | | 14 13.8 | +35 58 | 4.8 | 0.016 | Ko | G9 | 2.1 | 0.029 | | |
| C1882 | Lal. 26196 | 14 14.4 | − 4 41 | 7.6 | 0.664 | K2 | K1 | 6.3 | 0.055 | 0.116 | Y, F |
| C1885 | Lal. 26294 | 14 17.6 | +30 6 | 8.6 | 0.727 | K6 | K5 | 8.4 | 0.091 | | |
| 3691 | 2 Librae | 14 18.0 | −11 15 | 6.3 | 0.066 | G8 | G7 | 1.7 | 0.012 | | |
| C1886 | Lal. 26289 | 14 18.1 | + 1 43 | 6.3 | 0.525 | G2 | G2 | 5.7 | 0.076 | 0.070 | Y, F |
| 3692 | Bu. 6842 BC | 14 18.5 | + 8 54 | 7.4† | 0.072 | Fo | F3 | 2.2 | 0.009 | 0.018 | Ye, S |
| C1894 | A.G. Berlin 5072 | 14 21.1 | +24 6 | 9.5 | 1.39 | Ma | K5 | 9.5 | 0.100 | 0.062 | Ye, R |
| 3703 | | 14 21.4 | +38 51 | 6.3 | 0.019 | K1 | Ko | 1.0 | 0.009 | | |
| 3704 | θ Boötis | 14 21.8 | +52 19 | 4.1 | 0.471 | F6 | F7 | 3.0 | 0.060 | 0.067 | A |
| 3715 | 24 Boötis | 14 25.2 | +50 18 | 5.6 | 0.312 | G3 | G2 | 1.8 | 0.017 | 0.023 | A |
| C1908 | Lal. 26481 Br. | 14 25.8 | −15 11 | 8.2† | 0.433 | G2 | G2 | 5.3 | 0.026 | 0.238 | F |
| 3717 | ρ Boötis | 14 27.5 | +30 49 | 3.8 | 0.149 | K3 | K1 | 0.8 | 0.025 | 0.036 | A |
| 3718 | 5 Urs. Min. | 14 27.7 | +76 8 | 4.4 | 0.021 | K4 | K1 | 0.9 | 0.020 | | |
| 3722 | γ Boötis | 14 28.1 | +38 45 | 3.0 | 0.182 | A7 | ..... | 1.8 | 0.058 | | |
| C1913 | B.D. +10° 2703 | 14 28.7 | + 9 47 | 8.9 | 0.55 | K3 | K1 | 6.2 | 0.029 | | |
| 3729 | σ Boötis | 14 30.3 | +30 11 | 4.5 | 0.228 | Fo | ..... | 2.9 | 0.048 | | |
| 3734 | | 14 31.7 | −11 53 | 6.2 | 0.946 | F4 | F5 | 3.2 | 0.025 | 0.049 | Y |
| 3735 | α Centauri Br.* | 14 32.8 | −60 25 | 0.3 | 3.680 | G6 | G5 | 4.8 | 0.794 | 0.759 | C, Wr |
| 3735 | α Centauri Ft.* | 14 32.8 | −60 25 | 1.7 | 3.680 | K4 | K3 | 6.2 | 0.794 | | |

TABLE VII—*Continued*

| Boss | Name | α 1900 | δ 1900 | Harv. Vis. Mag. | μ | Spectrum | | Spect. Abs. Mag. | Spect. π | Trig. π | Auth. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Est. | Meas. | | | | |
| 3736 | | $14^h33^m6$ | +18°44′ | 6.0 | 0″.096 | Ko | G9 | 1.9 | 0″.015 | 0″.057 | W |
| 3754 | 32 Boötis | 14 36.9 | +12 5 | 5.6 | 0.205 | G5 | G5 | 1.0 | 0.012 | | |
| 3758 | μ Virginis | 14 37.8 | − 5 13 | 4.0 | 0.339 | F1 | F3 | 2.4 | 0.048 | 0.048 | M |
| C1939 | Bu. 6977 | 14 38.2 | +58 23 | 7.4† | 0.244 | Ko | G9 | 4.6 | 0.028 | | |
| 3771 | ε Boötis Br. | 14 40.6 | +27 30 | 2.7 | 0.049 | G8 | G7 | −0.9 | 0.019 | 0.015 | A, F |
| | A.G. Leiden 5276 | 14 41.1 | +34 48 | 7.8 | 0.044‡ | Ma | G8 | 0.8 | 0.004 | | |
| C1947 | Bu. 6999 | 14 41.4 | +10 4 | 7.5† | 0.272 | G3 | G2 | 5.2 | 0.035 | | |
| | Bu. 7001 | 14 41.7 | +42 48 | 7.8† | 0.129* | F5 | F7 | 3.2 | 0.012 | −0.022 | S |
| | A.G. Berlin 5351 | 14 44.2 | +18 37 | 7.4 | 0.026‡ | Ko | G8 | 2.2 | 0.009 | | |
| 3785 | | 14 45.2 | +38 13 | 6.0 | 0.276 | F2 | F2 | 2.4 | 0.019 | 0.015 | A |
| | RY Boötis § | 14 45.2 | +23 27 | 7.2 | 0.051‖ | F2 | F4 | 0.5: | 0.005 | | |
| 3790 | 11 Librae | 14 45.8 | − 1 53 | 5.0 | 0.160 | G6 | G4 | 0.8 | 0.014 | | |
| C1962 | Lal. 27026 | 14 46.0 | −23 53 | 7.6 | 1.022 | K5 | K5 | 6.9 | 0.072 | 0.041 | F |
| 3798 | ξ Boötis Br. | 14 46.8 | +19 31 | 4.8 | 0.168 | G6 | G6 | 5.8 | 0.158 | 0.178 | A, M |
| 3798 | ξ Boötis Ft. | 14 46.8 | +19 31 | 6.8 | 0.168 | K4 | K3 | 6.9 | 0.105 | | |
| | Groom. 2165 | 14 48.6 | +66 3 | 7.2 | 0.007 | Ma | G8 | 0.4 | 0.004 | | |
| C1972 | Lal. 27137 | 14 48.9 | +19 33 | 6.0 | 0.485 | K1 | Ko | 5.9 | 0.095 | 0.086 | A |
| C1973 | Lal. 27155 | 14 49.3 | +23 45 | 8.7 | 0.817 | K4 | K3 | 6.9 | 0.044 | | |
| 3809 | β Urs. Min. | 14 51.0 | +74 34 | 2.2 | 0.030 | K4 | Ko | 0.5 | 0.046 | 0.014 | F |
| 3810 | 15 Librae | 14 51.3 | −11 0 | 5.6 | 0.002 | K2 | Ko | 1.2 | 0.013 | | |
| 3812 | Bu. 7060 Ft. | 14 51.6 | −20 58 | 8.9 | 1.916 | Ma | ..... | 9.9 | 0.158 | 0.194 | M, F, Sitt |
| 3813 | Bu. 7060 Br. | 14 51.6 | −20 58 | 5.8 | 2.039 | K3 | K6 | 6.7 | 0.151 | | |
| C1980 | Lal. 27298 | 14 52.3 | +54 4 | 7.9 | 1.086 | K1 | G8 | 6.3 | 0.048 | 0.056 | Ye, Y, P, F |
| 3816 | 1 Serpentis | 14 52.4 | + 0 14 | 5.7 | 0.069 | K1 | K1 | 1.8 | 0.017 | 0.044 | W |
| C1986 | Pi. $14^h229$ | 14 53.7 | − 4 35 | 6.0 | 0.384 | F8 | F8 | 4.0 | 0.040 | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C1988 | Lal. 27274 | 14h54m2 | −21°36′ | 8.5 | 0″.785 | F4 | F6 | 3.3 | 0″.009 | | |
| 3827 | | 14 56.0 | +66 20 | 4.9 | 0.082 | Mb | G8 | −0.6 | 0.008 | | |
| 3833 | | 14 57.1 | +82 55 | 5.7 | 0.294 | F8 | F9 | 3.6 | 0.038 | 0″.010 | G |
| 3836 | β Boötis | 14 58.2 | +40 47 | 3.6 | 0.063 | G4 | G5 | −0.7 | 0.014 | 0.030 | A, M |
| 3837 | σ Librae | 14 58.2 | −24 53 | 3.4 | 0.094 | Mb | G7 | 0.7 | 0.029 | | |
| 3842 | ψ Boötis | 15 0.2 | +27 20 | 4.7 | 0.178 | K2 | K0 | 0.9 | 0.017 | | |
| 3843 | 9 Urs. Min. | 15 0.3 | +72 9 | 6.7 | 0.398 | F9 | G0 | 4.3 | 0.033 | 0.043 | G |
| 3846 | 44 Boötis Ft.* | 15 0.5 | +48 3 | 6.1 | ..... | G2p | G4 | 5.2 | 0.066 | | |
| 3847 | 44 Boötis Br. | 15 0.5 | +48 3 | 5.3 | 0.387 | G0 | G0 | 4.6 | 0.072 | | |
| 3855 | 45 Boötis | 15 2.9 | +25 16 | 5.0 | 0.262 | F4 | F4 | 3.3 | 0.046 | 0.059 | A |
| C2010 | Lal. 27531 | 15 2.9 | − 7 31 | 8.1 | 0.484 | F9 | G0 | 3.9 | 0.014 | | |
| C2011 | Lal. 27558 | 15 3.0 | + 9 16 | 8.7 | 0.534 | F6 | F9 | 4.2 | 0.013 | | |
| C2019 | A.Oe. 14320 | 15 4.7 | −15 54 | 9.4 | 3.680 | G9 | G5 | 5.7 | 0.018 | 0.039 | Ye, R, V |
| 3867 | | 15 7.5 | +19 21 | 6.0 | 0.004 | Mb | G7 | 0.2 | 0.007 | 0.005 | W |
| C2024 | Lal. 27742 | 15 8.3 | +19 39 | 6.8 | 0.668 | G6 | G2 | 4.2 | 0.030 | 0.004 | Y, R |
| C2025 | Lal. 27743 | 15 8.3 | +19 40 | 7.6 | 0.654 | G7 | G5 | 5.2 | 0.033 | | |
| C2027 | Lal. 27744 | 15 8.8 | − 0 58 | 7.2† | 1.376 | K0 | G7 | 5.8 | 0.052 | 0.070 | Ye, Y, F |
| 3882 | 3 Serpentis | 15 10.2 | + 5 19 | 5.4 | 0.023 | G9 | G7 | 0.8 | 0.012 | | |
| 3887 | δ Boötis | 15 11.5 | +33 41 | 3.5 | 0.155 | G5 | G5 | −0.6 | 0.015 | 0.031 | A |
| 3895 | 5 Serpentis | 15 14.2 | + 2 9 | 5.2 | 0.644 | F6 | F7 | 3.5 | 0.046 | 0.055 | A, Y |
| C2043 | Lal. 27922 | 15 14.6 | − 8 18 | 7.9 | 0.211 | F9 | F9 | 3.5 | 0.013 | −0.005 | A |
| C2044 | Lal. 27958 | 15 14.7 | +26 4 | 8.1 | 0.568 | G9 | G5 | 5.4 | 0.029 | 0.031 | Y |
| 3900 | 28 Librae | 15 15.2 | −17 48 | 6.2 | 0.069 | G8 | G6 | 0.9 | 0.009 | | |
| 3907 | 6 Serpentis | 15 15.9 | + 1 5 | 5.5 | 0.125 | K2 | K2 | 1.8 | 0.018 | 0.133 | F |
| ..... | A.G. Leiden 5456 | 15 16.1 | +31 3 | 9.9 | ..... | F5 | F6 | 3.5 | 0.005 | | |
| C2055 | W.B. 15h 268 | 15 17.7 | + 1 47 | 8.7 | 0.507 | K4 | K3 | 6.7 | 0.040 | 0.118 | Y |
| 3923 | η Cor. Bor. | 15 19.1 | +30 39 | 5.6† | 0.237 | G0 | G0 | 4.3 | 0.055 | 0.084 | S, Ye |
| 3926 | $\mu^1$ Boötis | 15 20.7 | +37 44 | 4.5 | 0.169 | F0 | ..... | 2.2 | 0.035 | 0.046 | M, S, F |
| 3927 | $\mu^2$ Boötis | 15 20.7 | +37 42 | 7.2† | 0.172 | G0 | G0 | 4.7 | 0.032 | | |
| 3931 | 9 Serpentis | 15 21.2 | +15 47 | 5.5 | 0.033 | K6 | K0 | 0.2 | 0.009 | | |

TABLE VII—*Continued*

| Boss | Name | α 1900 | δ 1900 | Harv. Vis. Mag. | μ | Spectrum Est. | Spectrum Meas. | Spect. Abs. Mag. | Spect. π | Trig. π | Auth |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ..... | A.G. Berlin 5543..... | $15^h21^m6$ | +18°31′ | 8.3† | 0″023‡ | F7 | F7 | 2.8 | 0″008 | | |
| 3936..... | ι Draconis..... | 15 22.7 | +59 19 | 3.5 | 0.010 | K3 | K1 | 0.1 | 0.021 | 0″025 | A |
| C2064..... | Bu. 7268 Br..... | 15 22.7 | − 8 59 | 6.8 | 0.349 | G8 | G7 | 5.5 | 0.055 | | |
| ..... | Bu. 7268 Ft..... | 15 22.7 | − 8 59 | 8.1 | 0.349 | K2 | K2 | 6.0 | 0.038 | | |
| C2067..... | B.D. +67° 887..... | 15 23.1 | +66 54 | 9.0 | 0.28 | G8 | G7 | 5.1 | 0.017 | 0.017 | G |
| 3938..... | ..... | 15 23.3 | +25 27 | 6.3 | 0.039 | Ma | G9 | −0.1 | 0.005 | | |
| 3940..... | β Cor. Bor..... | 15 23.7 | +29 27 | 3.7 | 0.190 | F2 | F4 | −0.3 | 0.016 | | |
| 3942..... | 34 Librae..... | 15 25.0 | −16 16 | 5.9 | 0.019 | G9 | G8 | 1.2: | 0.012 | | |
| C2071..... | Lal. 28358..... | 15 26.6 | +57 47 | 6.9 | 0.299 | F5 | F6 | 4.2 | 0.029 | 0.029 | F |
| 3952..... | 37 Librae..... | 15 28.7 | − 9 43 | 4.8 | 0.389 | K1 | K0 | 2.9 | 0.042 | | |
| 3959..... | γ Librae..... | 15 29.9 | −14 27 | 4.0 | 0.065 | G9 | G8 | 0.5 | 0.020 | | |
| 3960..... | δ Serpentis Br..... | 15 30.0 | +10 52 | 4.2 | 0.068 | A7 | ..... | 1.4 | 0.028 | 0.013 | Ye |
| 3960..... | δ Serpentis Ft..... | 15 30.0 | +10 52 | 5.2 | 0.068 | A8 | ..... | 1.5 | 0.018 | | |
| 3963..... | 15 Serpentis..... | 15 31.0 | +17 59 | 6.1 | 0.081 | G7 | G6 | 1.0 | 0.010 | | |
| 3968..... | 16 Serpentis..... | 15 31.7 | +10 21 | 5.4 | 0.139 | G4 | G6 | 0.1 | 0.009 | | |
| C2086..... | W.B. $15^h716$..... | 15 32.4 | +40 10 | 7.9 | 0.455 | K4 | K5 | 6.6 | 0.055 | 0.046 | R |
| C2087..... | W.B. $15^h720$..... | 15 32.5 | +40 8 | 7.4† | 0.456 | K3 | K2 | 6.1 | 0.055 | | |
| 3983..... | Bu. 7362 Br..... | 15 35.0 | +80 47 | 6.9 | 0.246 | G3 | G3 | 5.7 | 0.058 | 0.022 | W |
| 4001..... | α Serpentis..... | 15 39.3 | + 6 44 | 2.8 | 0.139 | K2 | K1 | −0.2 | 0.025 | 0.056 | A, M, F |
| 4010..... | λ Serpentis..... | 15 41.6 | + 7 40 | 4.4 | 0.244 | Go | Go | 4.4 | 0.100 | 0.086 | A |
| C2112..... | Groom. 2273..... | 15 41.7 | +53 18 | 7.3 | 0.261 | G2 | G3 | 4.8 | 0.032 | 0.015 | A |
| 4015..... | κ Serpentis..... | 15 44.2 | +18 27 | 4.3 | 0.110 | Ma | K0 | 0.0 | 0.014 | | |
| 4024..... | δ Cor. Bor..... | 15 45.4 | +26 22 | 4.7 | 0.110 | G4 | G3 | 1.7 | 0.025 | 0.013 | A |
| 4029..... | ..... | 15 46.1 | −13 50 | 6.2 | 0.044 | G5 | G3 | 0.3 | 0.007 | | |
| 4031..... | ρ Serpentis..... | 15 46.9 | +21 17 | 4.9 | 0.049 | K5 | K2 | 0.7 | 0.014 | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 4032 | κ Cor. Bor. | $15^h47^m5$ | +35°58′ | 4.8 | 0″364 | K1 | K0 | 1.6 | 0″023 | 0″030 | A |
| 4040 | 39 Serpentis | 15 48.5 | +13 31 | 6.2 | 0.586 | G1 | G1 | 5.1 | 0.060 | 0.031 | A, Y |
| 4042 | χ Herculis | 15 49.2 | +42 44 | 4.6 | 0.760 | F7 | F9 | 4.2 | 0.083 | 0.099 | Y |
| 4048 | | 15 50.2 | +20 36 | 5.8 | 0.083 | K4 | G8 | 0.8 | 0.010 | 0.040 | W |
| 4054 | 2 Herculis | 15 51.3 | +43 26 | 5.5 | 0.075 | Ma | G8 | 0.6 | 0.011 | | |
| 4055 | γ Serpentis | 15 51.8 | +15 59 | 3.9 | 1.332 | F5 | F6 | 4.3 | 0.120 | 0.063 | A, M, Y, *et al.* |
| 4063 | ε Cor. Bor. | 15 53.4 | +27 10 | 4.2 | 0.109 | K2 | K1 | 0.9 | 0.022 | | |
| C2134 | W.B. $15^h1323$ | 15 54.5 | +28 1 | 8.1 | 0.85 | G8 | G8 | 6.0 | 0.038 | | |
| 4067 | 49 Librae | 15 54.7 | −16 14 | 5.5 | 0.750 | F6 | F6 | 3.6 | 0.042 | | |
| 4075 | 5 Herculis | 15 56.7 | +18 6 | 5.3 | 0.153 | G7 | G7 | 0.7 | 0.012 | | |
| 4077 | ρ Cor. Bor. | 15 57.2 | +33 36 | 5.4 | 0.810 | F9 | G0 | 3.6 | 0.044 | 0.035 | A, M, Y |
| 4082 | $\xi^1$ Scorpii | 15 58.9 | −11 6 | 4.8† | 0.071 | F5 | F6 | 3.0 | 0.044 | 0.046 | M, Ye |
| 4083 | $\xi^2$ Scorpii | 15 58.9 | −11 6 | 7.2 | 0.080 | G7 | G6 | 5.0 | 0.036 | | |
| C2149 | Lal. 29307 | 15 59.9 | +25 31 | 7.1 | 0.862 | K0 | G7 | 5.7 | 0.052 | 0.058 | Ye |
| 4090 | θ Draconis | 16 0.0 | +58 50 | 4.1 | 0.459 | F7 | F8 | 3.2 | 0.066 | 0.066 | Kos |
| C2152 | Lal. 29330 | 16 1.2 | +10 57 | 8.5 | 0.491 | K0 | G9 | 6.0 | 0.032 | | |
| C2154 | Groom. 2305 | 16 1.5 | +39 26 | 6.8 | 0.571 | G9 | G5 | 6.1 | 0.072 | 0.069 | Y |
| 4096 | | 16 2.0 | −26 4 | 5.6 | 0.122 | Ma | G8 | 0.6 | 0.010 | | |
| C2160 | Lal. 29439 | 16 2.9 | +38 55 | 8.6 | 0.591 | K5 | K2 | 7.1 | 0.050 | 0.014 | Y, K |
| | Groom. 2312 | 16 3.3 | +70 23 | 8.2 | 0.020 | Mb | G9 | 1.0 | 0.004 | | |
| 4101 | κ Herculis Br. | 16 3.6 | +17 19 | 5.3 | 0.046 | G5 | G4 | −0.2 | 0.008 | −0.011 | Ye |
| 4102 | κ Herculis Ft. | 16 3.6 | +17 19 | 6.5 | 0.048 | K2 | K1 | 1.1 | 0.008 | | |
| 4103 | 47 Serpentis | 16 3.6 | + 8 48 | 5.9 | 0.024 | Mb | G6 | 0.4 | 0.008 | | |
| C2163 | Lal. 29437 | 16 4.3 | + 6 40 | 6.0 | 0.760 | K0 | K2 | 4.4 | 0.048 | 0.014 | A, Y |
| 4106 | | 16 4.6 | − 3 12 | 5.4 | 0.016 | K5 | K2 | 0.3 | 0.010 | | |
| 4108 | τ Cor. Bor. | 16 5.3 | +36 45 | 4.9 | 0.325 | K0 | K0 | 2.8 | 0.038 | 0.044 | A |
| 4125 | 10 Herculis | 16 7.4 | +23 45 | 6.0 | 0.028 | Mc | G7 | 0.0 | 0.006 | | |
| 4130 | 9 Herculis | 16 8.3 | + 5 17 | 5.6 | 0.046 | K4 | K2 | 0.8 | 0.011 | 0.008 | W |
| 4131 | χ Scorpii | 16 8.3 | −11 35 | 5.5 | 0.020 | K2 | K0 | 1.1 | 0.013 | | |
| 4132 | Bu. 7551 S | 16 8.6 | +13 48 | 7.6 | 0.459 | G9 | G7 | 5.3 | 0.035 | 0.078 | M |
| 4132 | Bu. 7551 N | 16 8.6 | +13 48 | 7.6 | 0.459 | G9 | G8 | 4.7 | 0.026 | | |

TABLE VII—*Continued*

| Boss | Name | α 1900 | δ 1900 | Harv. Vis. Mag. | μ | Spectrum | | Spect. Abs. Mag. | Spect. π | Trig. π | Auth. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Est. | Meas. | | | | |
| ..... | A.G. Leiden 5723..... | 16h 9m.0 | +32°51′ | 7.9 | 0″.027‡ | K1 | K0 | 1.0 | 0″.004 | | |
| 4134..... | δ Ophiuchi..... | 16 9.1 | − 3 26 | 3.0 | 0.161 | K8 | G8 | 0.3 | 0.029 | 0″.045 | M |
| 4137..... | 18 Scorpii..... | 16 10.2 | − 8 6 | 5.6 | 0.563 | G2 | G1 | 4.7 | 0.066 | 0.039 | Y |
| 4138..... | $\sigma^1$ Cor. Bor. Ft..... | 16 10.9 | +34 7 | 6.7 | 0.302 | F9 | F9 | 4.2 | 0.032 | 0.044 | A, F |
| 4138..... | $\sigma^2$ Cor. Bor. Br..... | 16 10.9 | +34 7 | 5.8 | 0.302 | F8 | G0 | 3.7 | 0.038 | | |
| ..... | A.G. Leiden 5734..... | 16 11.4 | +32 24 | 8.5 | 0.035‡ | K4 | G8 | 1.0 | 0.003 | | |
| ..... | A.G. Berlin 5827..... | 16 12.5 | +19 6 | 7.6 | 0.034‡ | K2 | K0 | 1.7: | 0.006 | | |
| 4147..... | ε Ophiuchi..... | 16 13.0 | − 4 27 | 3.3 | 0.086 | G6 | G6 | 0.0 | 0.022 | 0.051 | M |
| ..... | A.G. Lund 6686..... | 16 13.2 | +38 53 | 8.0 | 0.026‡ | K3 | G9 | 0.9 | 0.004 | | |
| 4150..... | ..... | 16 13.3 | −19 58 | 6.4 | 0.026 | G5 | G5 | 0.3 | 0.006 | | |
| 4152..... | ..... | 16 14.0 | +66 37 | 8.2 | 0.011 | K2 | G8 | 1.2 | 0.004 | | |
| 4157..... | 20 Urs. Min..... | 16 15.0 | +75 28 | 6.5 | 0.041 | K2 | K1 | 0.7 | 0.007 | | |
| 4159..... | ..... | 16 15.6 | +60 0 | 5.6 | 0.022 | Mb | G6 | −0.3 | 0.007 | | |
| C2184..... | Lal. 29917..... | 16 16.5 | +67 29 | 8.9 | 0.505 | K6 | K4 | 8.0 | 0.066 | 0.117 | D, Y |
| 4163..... | σ Serpentis..... | 16 17.0 | + 1 16 | 4.8 | 0.172 | A9 | ..... | 1.5 | 0.022 | 0.031 | A |
| 4165..... | γ Herculis..... | 16 17.5 | +19 23 | 3.8 | 0.062 | A7 | ..... | 1.4 | 0.033 | 0.017 | A |
| 4169..... | ξ Cor. Bor..... | 16 18.2 | +31 7 | 4.7 | 0.132 | G9 | G9 | 0.7 | 0.016 | 0.014 | A |
| 4173..... | $\nu^1$ Cor. Bor..... | 16 18.6 | +34 2 | 5.4 | 0.049 | Ma | G9 | 0.3 | 0.010 | | |
| 4175..... | $\nu^2$ Cor. Bor..... | 16 18.7 | +33 56 | 5.3 | 0.055 | K6 | K2 | 0.6 | 0.012 | | |
| ..... | A.G. Leiden 5784..... | 16 19.2 | +32 52 | 7.9 | 0.011‡ | K4 | K0 | 0.7 | 0.004 | | |
| 4181..... | η Urs. Min..... | 16 20.4 | +75 59 | 5.0 | 0.261 | A8 | ..... | 1.7 | 0.022 | | |
| ..... | A.G. Leiden 5792..... | 16 20.7 | +32 42 | 8.1 | 0.038‡ | K4 | K1 | 0.7 | 0.003 | | |
| ..... | A.G. Berlin 5877..... | 16 21.0 | +17 32 | 7.9 | 0.019‡ | G0 | F9 | 3.2 | 0.012 | | |
| 4188..... | ..... | 16 22.3 | − 7 22 | 5.4 | 0.176 | Mb | G8 | −0.5 | 0.007 | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 4192 | $\eta$ Draconis | $16^h22^m6$ | +61° 44′ | 2.9 | 0″.062 | G6 | G5 | 0.7 | 0″.036 | 0″.019 | M, F |
| 4193 | $\alpha$ Scorpii | 16 23.3 | −26 13 | 1.2 | 0.034 | Ma | G2 | −2.7 | 0.017 | 0.029 | C |
| 4195 | | 16 23.5 | + 0 53 | 5.5 | 0.076 | K5 | K3 | 0.5 | 0.010 | 0.016 | W |
| C2199 | Bu. 7642 | 16 24.5 | +18 37 | 7.8† | 0.508 | K3 | K2 | 6.6 | 0.058 | 0.088 | Y |
| 4202 | $\phi$ Ophiuchi | 16 25.4 | −16 24 | 4.4 | 0.066 | G5 | G6 | −0.3 | 0.012 | | |
| C2201 | Lal. 30044 | 16 25.6 | + 4 26 | 7.4 | 1.450 | F7 | F6 | 4.0 | 0.021 | 0.025 | A, Y, F |
| 4204 | $\beta$ Herculis | 16 25.9 | +21 42 | 2.8 | 0.107 | G5 | G6 | −1.0 | 0.017 | 0.020 | F |
| 4206 | $\omega$ Ophiuchi | 16 26.2 | −21 15 | 4.6 | 0.033 | A7 | ..... | 1.7 | 0.026 | | |
| C2202 | Groom. 2354 | 16 27.4 | +48 11 | 7.0 | 0.301 | F7 | F8 | 3.8 | 0.023 | 0.001 | A |
| 4211 | 31 Herculis | 16 27.8 | +33 44 | 6.7 | 0.039 | K4 | K1 | 0.5 | 0.006 | | |
| 4212 | 29 Herculis | 16 27.9 | +11 42 | 4.9 | 0.204 | K6 | K2 | 0.5 | 0.013 | −0.012 | A |
| 4222 | 12 Ophiuchi | 16 31.1 | − 2 7 | 5.9 | 0.546 | Ko | G9 | 5.6 | 0.087 | 0.088 | A |
| C2214 | Lal. 30271 | 16 32.6 | +31 9 | 7.3 | 0.482 | F7 | F6 | 4.1 | 0.023 | 0.054 | A, D, Y |
| 4228 | | 16 33.3 | +46 49 | 6.0 | 0.020 | G6 | G6 | −0.3 | 0.007 | | |
| ..... | B.D. +51° 2121 | 16 34.2 | +51 45 | 9.6 | 0.119 | G3 | G2 | 4.8 | 0.011 | 0.017 | K |
| 4234 | | 16 34.9 | +77 39 | 6.4 | 0.286 | G8 | G6 | 2.4 | 0.016 | | |
| 4239 | 24 Scorpii | 16 35.8 | −17 33 | 5.0 | 0.025 | G5 | G5 | −0.4: | 0.008 | | |
| 4242 | 42 Herculis | 16 36.0 | +49 7 | 5.1 | 0.044 | Ma | G9 | −0.3 | 0.008 | | |
| 4246 | $\zeta$ Herculis Br. | 16 37.5 | +31 47 | 3.0 | 0.604 | G1 | G1 | 2.4 | 0.076 | 0.114 | A, Ye, S, *et al.* |
| 4255 | $\eta$ Herculis | 16 39.5 | +39 7 | 3.6 | 0.101 | G5 | G5 | 0.9 | 0.029 | 0.056 | A, M, R, F |
| 4257 | 41 Herculis | 16 40.1 | + 6 17 | 6.7 | 0.352 | G8 | G8 | 4.7 | 0.040 | 0.024 | A, Ye |
| 4259 | 18 Draconis | 16 40.2 | +64 47 | 5.0 | 0.017 | K1 | G8 | 1.4 | 0.019 | | |
| 4262 | | 16 40.8 | +15 56 | 5.8 | 0.054 | Mb | G9 | 0.8 | 0.010 | 0.022 | W |
| 4264 | 43 Herculis | 16 41.0 | + 8 46 | 5.4 | 0.016 | K5 | K3 | 0.8 | 0.012 | | |
| C2238 | W.B. $16^h1259$ | 16 41.4 | +33 41 | 8.6 | 0.37 | K8 | K5 | 9.0 | 0.120 | 0.199 | D |
| C2242 | Lal. 30699 | 16 42.9 | +68 16 | 7.6 | 0.509 | G9 | G6 | 5.4 | 0.036 | 0.047 | Y |
| 4270 | | 16 43.4 | +56 58 | 4.9 | 0.062 | Fo | F1 | 2.3 | 0.030 | | |
| 4273 | 20 Ophiuchi | 16 44.3 | −10 36 | 4.7 | 0.133 | F5 | F5 | 2.7 | 0.040 | | |
| ..... | Bu. 7778 | 16 46.4 | + 9 34 | 7.0† | ..... | F6 | F6 | 3.1 | 0.017 | 0.001 | A |
| ..... | Bu. 7783 | 16 47.9 | +28 49 | 6.7† | ..... | F4 | F6 | 3.4 | 0.022 | 0.024 | A, Ye, S |

TABLE VII—*Continued*

| Boss | Name | α 1900 | δ 1900 | Harv. Vis. Mag. | μ | Spectrum | | Spect. Abs. Mag. | Spect. π | Trig. π | Auth. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Est. | Meas. | | | | |
| C2248 | Lal. 30694 | $16^h47^m9$ | + 0°11′ | 6.8 | 1″.664 | Ko | G6 | 5.8 | 0″.063 | 0″.099 | A, Y, F |
| C2251 | W.B. $16^h906$ | 16 50.1 | − 8 9 | 9.2 | 1.234 | Md | ..... | 10.1 | 0.151 | 0.150 | Ye, Y |
| 4303 | ..... | 16 50.3 | −16 39 | 6.5 | 0.089 | Ko | Ko | 4.1 | 0.033 | | |
| 4305 | ..... | 16 50.4 | +43 0 | 6.7 | 0.349 | F9 | G0 | 4.0 | 0.029 | 0.031 | A |
| 4307 | ..... | 16 50.6 | +21 7 | 5.5 | 0.059 | G7 | G6 | 0.9 | 0.012 | 0.001 | W |
| 4311 | 54 Herculis | 16 51.0 | +18 36 | 5.6 | 0.106 | K6 | K3 | 0.3 | 0.009 | 0.008 | A |
| 4315 | κ Ophiuchi | 16 52.9 | + 9 32 | 3.4 | 0.295 | K2 | K0 | 0.6 | 0.028 | | |
| 4316 | 57 Herculis | 16 53.4 | +25 30 | 6.7 | 0.008 | G5 | G5 | 0.8 | 0.007 | | |
| 4318 | ..... | 16 53.8 | −24 56 | 5.9 | 0.022 | Ma | K1 | 0.2 | 0.007 | | |
| 4322 | 19 Draconis | 16 55.5 | +65 17 | 4.8 | 0.252 | F7 | F8 | 3.6 | 0.058 | 0.087 | A |
| 4323 | 30 Ophiuchi | 16 55.8 | − 4 4 | 5.0 | 0.103 | K5 | K3 | 0.2 | 0.011 | | |
| 4326 | 29 Ophiuchi | 16 56.0 | −18 44 | 6.4 | 0.052 | K0 | G8 | 2.1 | 0.014 | | |
| 4327 | ε Urs. Min | 16 56.2 | +82 12 | 4.4 | 0.015 | G2 | G2 | −1.4 | 0.007 | | |
| 4336 | 32 Ophiuchi | 16 58.5 | +14 14 | 5.1 | 0.070 | Mb | K0 | −0.1 | 0.009 | | |
| C2277 | Lal. 31132 | 16 59.8 | +47 12 | 6.7 | 0.856 | K0 | G4 | 6.0 | 0.072 | 0.090 | A, Y |
| 4342 | ..... | 16 59.8 | − 4 54 | 7.9 | 1.464 | K5 | K5 | 7.9 | 0.100 | 0.060 | Ye, Y, F |
| 4343 | ..... | 16 59.9 | +35 33 | 6.8 | 0.058 | Mb | G7 | 0.1 | 0.005 | 0.009 | W |
| C2279 | Lal. 31065 | 17 0.2 | + 0 51 | 5.9 | 0.321 | G0 | F9 | 4.1 | 0.044 | 0.039 | A |
| 4354 | μ Draconis S. | 17 3.3 | +54 36 | 5.8 | 0.108 | F5 | F5 | 3.0 | 0.028 | | |
| 4354 | μ Draconis N. | 17 3.3 | +54 36 | 5.8 | 0.108 | F5 | F6 | 2.9 | 0.026 | | |
| ..... | Groom. 2420 | 17 3.4 | +73 27 | 7.7 | 0.007 | K5 | K0 | 0.7 | 0.004 | | |
| 4364 | ..... | 17 6.3 | +40 54 | 5.1 | 0.053 | K3 | K2 | 0.8 | 0.014 | | |
| 4370 | 36 Ophiuchi S. | 17 9.2 | −26 27 | 5.3 | 1.235 | K1 | K1 | 6.3 | 0.158 | | |
| 4371 | 36 Ophiuchi N. | 17 9.2 | −26 27 | 5.3 | 1.224 | K2 | K0 | 6.3 | 0.158 | 0.140 | F |
| 4372 | ..... | 17 10.1 | −26 24 | 6.7 | 1.223 | K4 | K3 | 7.3 | 0.132 | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 4373 | $\alpha^1$ Herculis | $17^h10^m1$ | +14°30′ | 3.5 | 0″.030 | Mb | G5 | −2.3 | 0″.007 | −0″.004 | A, M |
| 4374 | $\alpha^2$ Herculis | 17 10.1 | +14 30 | 5.4 | 0.032 | F9 | Go | 1.7 | 0.018 | | |
| 4379 | 41 Ophiuchi | 17 11.5 | − 0 20 | 4.8 | 0.065 | K2 | K1 | 1.2 | 0.019 | | |
| 4381 | $\pi$ Herculis | 17 11.6 | +36 55 | 3.4 | 0.025 | K4 | K1 | 0.4 | 0.025 | 0.017 | A |
| 4393 | | 17 14.9 | +28 56 | 5.8 | 0.045 | G8 | G8 | 0.6 | 0.009 | 0.015 | W |
| C2310 | Lal. 31528 | 17 15.4 | + 9 34 | 8.2 | 0.313 | Go | G1 | 4.3 | 0.017 | −0.017 | A |
| 4403 | 72 Herculis | 17 16.9 | +32 36 | 5.4 | 1.060 | F8 | G1 | 5.5 | 0.105 | 0.087 | A, S, Y, F |
| 4413 | | 17 18.7 | −21 21 | 6.0 | 0.045 | G8 | G5 | 1.7 | 0.014 | | |
| 4414 | | 17 19.0 | −24 9 | 6.3 | 0.004 | K1 | G8 | 1.3 | 0.010 | | |
| 4420 | 44 Ophiuchi | 17 20.3 | −24 5 | 4.3 | 0.132 | A9 | Fo | 1.6 | 0.029 | | |
| C2322 | W.B. $17^h322$ | 17 20.8 | + 2 14 | 7.9 | 1.315 | K5 | K6 | 8.0 | 0.105 | 0.132 | Ye, R, Y, F |
| 4423 | | 17 21.3 | − 5 0 | 5.0† | 0.104 | F1 | F3 | 2.1 | 0.026 | | |
| 4424 | | 17 21.4 | −12 25 | 6.3 | 0.075 | F6 | F6 | 3.1 | 0.023 | | |
| 4425 | $\sigma$ Ophiuchi | 17 21.6 | + 4 14 | 4.4 | 0.004 | K1 | G8 | 0.7 | 0.018 | | |
| 4433 | Bu. 8038 | 17 25.2 | − 0 59 | 6.0† | 0.215 | G6 | G5 | 5.0 | 0.063 | 0.065 | Ye, S |
| C2333 | Lal. 32047 | 17 25.3 | +67 23 | 6.3 | 0.536 | Ko | G8 | 5.9 | 0.083 | 0.071 | A, G, Y |
| | Lal. 31905 | 17 26.5 | + 1 45 | 7.2 | ..... | K2 | K3 | 2.1 | 0.010 | 0.039 | Y |
| 4438 | $\lambda$ Herculis | 17 26.7 | +26 11 | 4.5 | 0.021 | K2 | K1 | 0.4 | 0.015 | | |
| 4443 | $\beta$ Draconis § | 17 28.2 | +52 23 | 3.0 | 0.016 | Gop | F8 | −3.5 | 0.005 | 0.005 | A, M |
| 4447 | | 17 29.2 | +16 23 | 5.7 | 0.058 | G9 | G8 | 1.8 | 0.017 | | |
| C2341 | Bu. 8068 C | 17 29.9 | + 6 4 | 8.6 | 0.623 | F6 | F8 | 3.8 | 0.011 | −0.004 | Y |
| | Bu. 8068 A | 17 30.0 | + 6 6 | 7.9 | 0.070* | F8 | F7 | 3.8 | 0.015 | | |
| 4464 | 27 Draconis | 17 32.4 | +68 12 | 5.2 | 0.138 | G9 | G9 | 1.1 | 0.015 | | |
| C2347 | | 17 33.4 | +18 37 | 9.1 | 1.39 | K9 | K5 | 9.7 | 0.132 | 0.128 | Ye |
| 4470 | 26 Draconis | 17 34.0 | +61 57 | 5.3 | 0.563 | Go | Go | 4.0 | 0.055 | 0.084 | A, Ye, M, Y |
| | B.D. +18° 3424 | 17 34.3 | +18 37 | 9.4 | ..... | K2 | Ko | 6.1 | 0.022 | 0.008 | Ye |
| | 7: 1917 Serpentis* | 17 34.3 | −11 53 | 10.5 | ..... | A8p | ..... | 2.9 | 0.003 | | |
| C2351 | A.G. Chris. 2703 | 17 35.8 | +68 52 | 8.5 | 0.150 | Ko | G9 | 3.3 | 0.009 | | |
| C2353 | Lal. 32322 | 17 36.3 | +37 16 | 8.5 | 0.945 | F7 | F9 | 4.1 | 0.013 | | |
| C2354 | A.Oe. 17415 | 17 37.0 | +68 26 | 9.5 | 1.334 | Mb | ..... | 10.5 | 0.158 | 0.254 | Ye, G, F, *et al.* |

TABLE VII—*Continued*

| Boss | Name | α 1900 | δ 1900 | Harv. Vis. Mag. | μ | Spectrum | | Spect. Abs. Mag. | Spect. π | Trig. π | Auth. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Est. | Meas. | | | | |
| 4480 | Bu. 8114 Br. | 17h37m0 | +24°34′ | 6.5 | 0.″052 | K2 | K1 | 0.8 | 0.″007 | 0.″022 | W |
| | Bu. 8114 Ft. | 17 37.0 | +24 34 | 8.6 | 0.052 | Fo | F1 | 2.5 | 0.006 | | |
| | B.D. +68° 947 | 17 37.2 | +68 27 | 8.0 | ..... | F2 | F4 | 2.4 | 0.008 | 0.011 | Ye |
| 4483 | ω Draconis | 17 37.5 | +68 48 | 4.9 | 0.327 | F2 | F3 | 2.8 | 0.038 | 0.045 | A |
| 4487 | β Ophiuchi | 17 38.5 | + 4 37 | 2.9 | 0.158 | K2 | K1 | 0.6 | 0.035 | 0.025 | A, M |
| C2358 | Lal. 32390 | 17 39.0 | +21 40 | 7.4 | 0.623 | G8 | G7 | 5.8 | 0.048 | | |
| 4488 | 84 Herculis | 17 39.3 | +24 22 | 5.7 | 0.132 | G2 | G2 | 3.3 | 0.033 | 0.006 | A |
| 4493 | X Sagittarii § | 17 41.3 | −27 48 | 4.7 | 0.023 | F9p | F8 | −1.3 | 0.006 | | |
| 4497 | μ Herculis A | 17 42.5 | +27 47 | 3.5 | 0.817 | G5 | G5 | 3.7 | 0.110 | 0.105 | A, M, Y, *et al.* |
| 4504 | ψ Draconis Br. | 17 43.7 | +72 12 | 4.9 | 0.267 | F3 | F6 | 3.1 | 0.044 | 0.030 | A |
| 4505 | ψ Draconis Ft. | 17 43.7 | +72 12 | 6.1 | 0.279 | F7 | F9 | 3.7 | 0.033 | | |
| 4508 | 87 Herculis | 17 44.8 | +25 39 | 5.3 | 0.046 | K1 | G9 | 1.6 | 0.018 | | |
| | Groom. 2485 | 17 50.9 | +42 40 | 7.6 | 0.004 | Ko | G7 | 2.4 | 0.009 | | |
| 4530 | ..... | 17 51.6 | +22 29 | 5.7 | 0.002 | K2 | Ko | 0.3 | 0.008 | | |
| 4531 | ξ Draconis | 17 51.8 | +56 53 | 3.9 | 0.123 | K3 | K1 | 0.7 | 0.023 | 0.026 | A |
| 4535 | θ Herculis | 17 52.8 | +37 16 | 4.0 | 0.006 | G9 | G7 | −0.3 | 0.014 | 0.000 | A |
| 4536 | ν Ophiuchi | 17 53.5 | − 9 46 | 3.5 | 0.118 | G7 | G8 | −0.2 | 0.018 | 0.029 | M |
| | Z Herculis | 17 53.6 | +15 9 | 7.6 | ..... | F2p | F5 | 2.7 | 0.011 | 0.033 | Ye |
| 4538 | ξ Herculis | 17 53.9 | +29 16 | 3.8 | 0.090 | G7 | G5 | 0.9 | 0.026 | 0.025 | A |
| 4539 | 35 Draconis | 17 53.9 | +76 59 | 5.0 | 0.244 | F5 | F6 | 3.2 | 0.044 | 0.012 | A, G |
| 4541 | γ Draconis | 17 54.3 | +51 30 | 2.4 | 0.027 | K5 | K1 | 0.6 | 0.044 | 0.012 | A, M, F, *et al.* |
| 4542 | ν Herculis § | 17 54.7 | +30 12 | 4.5 | 0.004 | F2p | F3 | −0.2 | 0.012 | | |
| 4544 | ρ Serpentis | 17 55.2 | − 3 41 | 4.6 | 0.153 | Fo | F3 | 1.9 | 0.029 | | |
| 4546 | 6 Sagittarii | 17 55.6 | −17 9 | 6.3 | 0.012 | K1 | G7 | 0.2 | 0.006 | | |
| 4547 | 93 Herculis | 17 55.6 | +16 45 | 4.7 | 0.012 | K2 | G8 | −0.3 | 0.010 | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 4554 | 34 Draconis | $17^h56^m.9$ | +72° 1′ | 5.5 | 0″.009 | F4 | F5 | 1.7 | 0″.017 | | |
| 4555 | | 17 57.1 | +45 30 | 5.9 | 0.044 | K6 | K3 | 0.6 | 0.009 | 0″.026 | W |
| 4556 | 95[1] Herculis | 17 57.3 | +21 36 | 5.2 | 0.030 | G1 | G2 | −0.3 | 0.008 | | |
| C2388 | W.B. $17^h1805$ | 17 58.4 | +26 20 | 7.1 | 0.72 | K1 | K0 | 6.0 | 0.060 | 0.040 | A |
| 4564 | W Sagittarii § | 17 58.6 | −29 35 | 4.7 | 0.015 | G0p | F5 | −2.0 | 0.004 | | |
| 4571 | 70 Ophiuchi Br | 18 0.4 | + 2 31 | 4.3 | 1.131 | K0 | G9 | 5.8 | 0.200 | 0.187 | A, M, Ye, *et al.* |
| 4571 | 70 Ophiuchi Ft | 18 0.4 | + 2 31 | 6.0 | 1.131 | K4 | K7 | 7.2 | 0.174 | | |
| C2392 | W.B. $17^h1236$ | 18 0.7 | + 4 39 | 6.8 | 0.296 | G1 | G0 | 5.4 | 0.052 | 0.053 | A |
| | Groom. 2506 | 18 1.4 | +42 51 | 7.5 | 0.035 | K2 | G8 | 1.1 | 0.005 | | |
| C2396 | Pi. $17^h368$ | 18 2.1 | + 8 52 | 7.7 | 0.152 | F7 | F7 | 3.2 | 0.013 | 0.009 | A |
| 4580 | 71 Ophiuchi | 18 2.5 | + 8 43 | 4.7 | 0.025 | G6 | G7 | −0.1 | 0.011 | | |
| 4582 | 99 Herculis | 18 3.2 | +30 33 | 5.2 | 0.113 | F5 | F7 | 4.4 | 0.069 | 0.045 | M, S, Ye, *et al.* |
| | W Serpentis §* | 18 4.1 | −15 34 | 9.0 | ..... | F9p | G0 | −0.6 | 0.001 | | |
| 4593 | | 18 4.6 | +36 23 | 5.7 | 0.213 | K3 | K1 | 0.6 | 0.010 | | |
| 4595 | | 18 4.9 | + 3 6 | 5.7 | 0.205 | F4 | F5 | 2.8 | 0.026 | 0.085 | A |
| | Groom. 2521 | 18 5.9 | +43 33 | 8.1 | 0.017 | K1 | G8 | 1.3 | 0.004 | | |
| C2403 | Lal. 33439 | 18 6.3 | +38 27 | 6.4 | 0.58 | K3 | K2 | 6.5 | 0.105 | 0.082 | A, Y |
| 4601 | | 18 6.5 | +36 27 | 5.9 | 0.009 | G7 | G6 | 1.0 | 0.011 | | |
| 4606 | 104 Herculis | 18 8.1 | +31 23 | 5.0 | 0.018 | Ma | K0 | −0.1 | 0.010 | | |
| 4609 | | 18 8.5 | +54 15 | 5.9 | 0.274 | G9 | G9 | 2.8 | 0.024 | 0.012 | A |
| | A.G. Leiden 6547 | 18 8.5 | +33 16 | 7.1 | 0.020‡ | K6 | K1 | 0.5 | 0.005 | | |
| 4618 | | 18 11.6 | − 3 2 | 6.1 | 0.274 | G2 | G2 | −0.3 | 0.005 | | |
| 4623 | 36 Draconis | 18 13.3 | +64 22 | 5.0 | 0.346 | F2 | F4 | 3.5 | 0.050 | | |
| 4629 | 105 Herculis | 18 15.1 | +24 24 | 5.5 | 0.016 | K2 | K0 | 0.2 | 0.009 | 0.002 | W |
| 4630 | | 18 15.4 | −24 58 | 6.4 | 0.011 | Mc | G5 | 0.8 | 0.007 | | |
| 4632 | Y Sagittarii § | 18 15.5 | −18 54 | 5.8 | 0.013 | G2p | F8 | −1.6 | 0.003 | | |
| 4635 | 74 Ophiuchi | 18 15.9 | + 3 20 | 4.9 | 0.015 | G5 | G7 | −0.5 | 0.008 | | |
| 4636 | 106 Herculis | 18 16.1 | +21 55 | 5.0 | 0.062 | K6 | K3 | 0.2 | 0.011 | | |
| 4638 | η Serpentis | 18 16.1 | − 2 55 | 3.4 | 0.898 | G8 | G7 | 2.5 | 0.066 | 0.057 | Y, J |
| 4647 | | 18 17.6 | +51 18 | 6.2 | 0.062 | K1 | K0 | 0.7 | 0.008 | 0.036 | W |

TABLE VII—*Continued*

| Boss | Name | α 1900 | δ 1900 | Harv. Vis. Mag. | μ | Spectrum | | Spect. Abs. Mag. | Spect. π | Trig. π | Auth. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Est. | Meas. | | | | |
| ..... | A.G. Leip. 8449..... | 18h18m0 | + 7° 9′ | 7.6 | 0″.012‡ | K2 | K1 | 0.8 | 0″.004 | | |
| 4650..... | ξ Scuti..... | 18 18.2 | − 8 59 | 4.8 | 0.062 | G8 | G8 | 0.4 | 0.013 | | |
| 4656..... | 109 Herculis..... | 18 19.4 | +21 43 | 3.9 | 0.324 | K1 | K0 | 1.5 | 0.033 | 0″.015 | A, Jo |
| ..... | Groom. 2557..... | 18 19.9 | +43 53 | 8.2 | 0.001 | G8 | G7 | 1.1 | 0.004 | | |
| ..... | A.G. Leip. 8478..... | 18 20.3 | + 9 41 | 7.9 | 0.016‡ | K3 | G8 | 0.8 | 0.004 | | |
| 4660..... | ..... | 18 20.8 | + 7 59 | 5.7 | 0.004 | G0 | G0 | −0.8 | 0.005 | | |
| C2420..... | B.D. +8° 3689..... | 18 21.4 | + 8 44 | 7.9 | 0.55 | G5 | G4 | 5.5 | 0.033 | 0.033 | A, K |
| C2421..... | B.D. +8° 3692..... | 18 21.6 | + 8 34 | 8.5 | 0.47 | G9 | G6 | 5.2 | 0.022 | 0.041 | A, K |
| 4665..... | λ Sagittarii..... | 18 21.8 | −25 29 | 2.9 | 0.197 | K0 | G9 | 3.2 | 0.115 | 0.069 | F |
| ..... | A.G. Leip. 8507..... | 18 22.0 | + 8 3 | 8.9 | 0.151 | G2 | G1 | 5.7 | 0.023 | 0.015 | K |
| 4672..... | χ Draconis..... | 18 22.9 | +72 41 | 3.7 | 0.638 | F5 | F6 | 4.1 | 0.120 | 0.105 | M, G, Y |
| C2423..... | Groom. 2571..... | 18 23.7 | +46 1 | 8.3 | 0.398 | G0 | F9 | 4.5 | 0.017 | 0.006 | A |
| 4678..... | 60 Serpentis..... | 18 24.5 | − 2 3 | 5.4 | 0.038 | G9 | G9 | 1.7 | 0.018 | | |
| ..... | Groom. 2577..... | 18 25.3 | +44 11 | 7.7 | 0.014 | K3 | K0 | 1.0 | 0.005 | | |
| 4686..... | 42 Draconis..... | 18 25.7 | +65 30 | 5.0 | 0.104 | K1 | G9 | 1.3 | 0.018 | | |
| ..... | U Sagittarii §..... | 18 26.0 | −19 12 | 6.9 | 0.012‖ | Gop | F7 | −1.4 | 0.002 | | |
| ..... | A.G. Leip. 8585..... | 18 26.1 | + 8 1 | 7.6 | 0.029‡ | Ma | K0 | 1.5 | 0.006 | | |
| 4688..... | ..... | 18 26.3 | +59 29 | 6.5 | 0.061 | G8 | G7 | 2.8 | 0.018 | | |
| 4701..... | ..... | 18 28.6 | +23 33 | 6.0 | 0.011 | K4 | K1 | 0.4 | 0.008 | | |
| 4705..... | 1 Aquilae..... | 18 29.8 | − 8 19 | 4.1 | 0.318 | K4 | K1 | 0.6 | 0.020 | | |
| ..... | Groom. 2622..... | 18 31.6 | +65 18 | 8.7 | 0.023 | F0 | ..... | 2.4 | 0.006 | | |
| 4711..... | ..... | 18 31.7 | +52 16 | 5.4 | 0.008 | G7 | G7 | −0.4 | 0.007 | | |
| 4713..... | ..... | 18 31.8 | + 6 36 | 5.4 | 0.146 | F0 | F1 | 1.6 | 0.017 | 0.024 | A |
| ..... | Bu. 8679..... | 18 33.2 | − 3 17 | 7.1† | ..... | G0 | F8 | 4.6 | 0.032 | 0.035 | Ye |
| 4723..... | ..... | 18 34.5 | +63 37 | 8.1 | 0.254 | F7 | F7 | 4.0 | 0.015 | 0.028 | A |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 4724 | | $18^h34^m6$ | +77° 28′ | 5.8 | 0″.006 | K2 | G8 | 0.6 | 0″.009 | | |
| 4731 | 2 Aquilae | 18 36.8 | − 9 9 | 4.7 | 0.014 | F5 | F3 | 1.3 | 0.021 | | |
| C2450 | W.B. $18^h1064$ | 18 37.1 | +31 28 | 8.8 | 0.82 | K3 | K2 | 6.6 | 0.036 | 0″.033 | A |
| 4750 | | 18 41.2 | −10 14 | 5.8 | 0.005 | F6 | F3 | 1.1 | 0.012 | | |
| 4753 | 110 Herculis | 18 41.4 | +20 27 | 4.3 | 0.345 | F4 | F6 | 3.3 | 0.063 | 0.057 | A, M, Jo |
| C2456 | Bu. 8798 Br. | 18 41.7 | +59 29 | 8.8 | 2.307 | Mb | ..... | 10.7 | 0.240 | 0.289 | Ye, D, R, *et al.* |
| 4758 | | 18 42.0 | +26 33 | 4.9 | 0.029 | K1 | G9 | 1.5 | 0.021 | | |
| 4763 | Bu. 8825 | 18 43.1 | +60 57 | 6.3† | 0.010 | K0 | G7 | 1.6 | 0.012 | | |
| ..... | YZ Sagittarii § | 18 43.7 | −16 50 | 7.4 | ..... | G1p | F9 | −2.7 | 0.001 | | |
| C2462 | Lal. 34986 | 18 43.8 | +10 39 | 8.0 | 0.463 | K4 | K4 | 6.8 | 0.058 | 0.062 | A, Y |
| ..... | Lal. 34958 | 18 44.1 | −10 29 | 7.9 | ..... | K2 | K1 | 4.9 | 0.025 | | |
| ..... | Bu. 8849 | 18 44.9 | +49 20 | 7.8† | ..... | F2 | F3 | 1.4 | 0.005 | 0.017 | Ye |
| 4780 | 33 Sagittarii | 18 48.0 | −21 29 | 5.8 | 0.012 | G9 | G5 | 0.2 | 0.008 | | |
| 4787 | | 18 49.3 | +52 51 | 5.6 | 0.288 | G8 | G8 | 3.2 | 0.033 | 0.048 | A |
| 4790 | o Draconis | 18 49.7 | +59 16 | 4.8 | 0.086 | G8 | G4 | −0.5 | 0.009 | | |
| 4797 | 113 Herculis | 18 50.5 | +22 31 | 4.6 | 0.005 | F9 | G0 | 1.7 | 0.026 | | |
| 4800 | 12 Lyrae | 18 51.0 | +36 46 | 4.5 | 0.010 | Mb | G4 | −1.2 | 0.007 | | |
| 4805 | | 18 51.7 | +41 28 | 5.6 | 0.007 | G8 | G9 | 0.0 | 0.008 | | |
| 4809 | 37 Sagittarii | 18 51.8 | −21 14 | 3.6 | 0.037 | K0 | K0 | 0.7 | 0.026 | | |
| 4814 | R Lyrae | 18 52.3 | +43 49 | 4.3 | 0.077 | Mc | G8 | −1.4 | 0.007 | 0.028 | Ab |
| C2475 | Mün. 18180 | 18 53.1 | + 5 48 | 9.8 | 1.247 | Ma | K6 | 9.7 | 0.095 | 0.069 | A, R |
| 4815 | | 18 53.3 | +32 46 | 5.2 | 0.235 | G0 | F9 | 4.8 | 0.083 | 0.095 | A, S, F, J |
| 4817 | | 18 53.8 | +17 14 | 5.4 | 0.009 | F8 | F7 | 0.3 | 0.010 | 0.001 | W |
| 4823 | ε Aquilae | 18 55.1 | +14 56 | 4.2 | 0.100 | K1 | K0 | 1.0 | 0.023 | | |
| ..... | A.G. Berlin 7148 | 18 56.2 | +18 20 | 8.0 | 0.017 | G7 | G4 | 1.7 | 0.006 | | |
| 4834 | 12 Aquilae | 18 56.3 | − 5 53 | 4.2 | 0.048 | K1 | K0 | 2.0 | 0.036 | | |
| 4847 | o Sagittarii | 18 58.7 | −21 53 | 3.9 | 0.098 | G8 | G9 | 1.3 | 0.030 | | |
| 4852 | 15 Aquilae Ft. | 18 59.7 | − 4 11 | 7.2 | 0.037 | K5 | K4 | 0.8 | 0.005 | | |
| 4860 | | 19 1.2 | +31 36 | 5.8 | 0.085 | K5 | K1 | 0.7 | 0.010 | c .026 | W |
| C2492 | B.D. +7° 3967 | 19 2.2 | + 7 29 | 9.5 | 0.812 | K5 | K3 | 7.8 | 0.046 | 0.040 | Ye |

TABLE VII—*Continued*

| Boss | Name | α 1900 | δ 1900 | Harv. Vis. Mag. | μ | Spectrum | | Spect. Abs. Mag. | Spect. π | Trig. π | Auth. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Est. | Meas. | | | | |
| ..... | TT Aquilae § | 19h 3m2 | + 1° 9′ | 7.6 | ..... | G2p | F9 | −1.4 | 0″.002 | | |
| C2495 | Lal. 35851 | 19 3.5 | +16 42 | 6.0 | 0″.308 | G4 | G4 | 3.7 | 0.035 | 0″.063 | A |
| 4874 | π Sagittarii § | 19 3.8 | −21 11 | 3.0 | 0.040 | F4p | F3 | −0.8 | 0.017 | 0.017 | M |
| 4880 | ..... | 19 6.5 | −21 49 | 6.4 | 0.032 | Ko | Ko | 1.4 | 0.010 | | |
| C2507 | Bu. 9114 A | 19 7.7 | +38 37 | 8.2 | 0.267 | G4 | G6 | 5.5 | 0.029 | 0.023 | M, S |
| C2507 | Bu. 9114 BC | 19 7.7 | +38 37 | 8.7† | 0.267 | Ko | G9 | 5.8 | 0.026 | | |
| C2508 | Bu. 9116 C | 19 8.0 | +16 41 | 7.6 | 0.243 | G6 | G7 | 5.0 | 0.030 | 0.021 | M |
| 4892 | Bu. 9137 Ft | 19 9.5 | +49 40 | 6.8 | 0.630 | G4 | G2 | 5.5 | 0.055 | 0.045 | M, W, R, *et al.* |
| 4893 | Bu. 9137 Br | 19 9.5 | +49 40 | 6.6 | 0.654 | G6 | G3 | 5.7 | 0.066 | | |
| ..... | Bu. 9136 | 19 10.0 | +18 54 | 7.7† | 0.031‡ | F7 | F7 | 3.3 | 0.013 | | |
| 4898 | ..... | 19 10.8 | +14 55 | 5.7 | 0.020 | G8 | G7 | −1.4 | 0.004 | | |
| 4903 | 43 Sagittarii | 19 11.8 | −19 8 | 5.0 | 0.023 | G7 | G6 | 0.5 | 0.013 | | |
| 4909 | δ Draconis | 19 12.5 | +67 29 | 3.2 | 0.133 | G8 | G7 | 0.8 | 0.033 | 0.035 | A |
| 4910 | ..... | 19 12.7 | +49 54 | 6.3 | 0.014 | G8 | G6 | 1.5 | 0.011 | | |
| 4912 | θ Lyrae | 19 12.9 | +37 57 | 4.5 | 0.010 | Ko | G7 | 0.2 | 0.014 | | |
| 4915 | ..... | 19 13.3 | −15 43 | 6.3 | 0.285 | K3 | G9 | 0.9 | 0.008 | | |
| 4919 | 24 Aquilae | 19 13.7 | + 0 9 | 6.5 | 0.009 | G9 | G7 | 1.2 | 0.009 | | |
| 4920 | ..... | 19 14.0 | +46 49 | 6.0 | 0.285 | F4 | F6 | 2.8 | 0.023 | 0.018 | A |
| 4923 | κ Cygni | 19 14.8 | +53 11 | 4.0 | 0.133 | G7 | G7 | 1.1 | 0.026 | 0.040 | A, Ab |
| 4926 | 26 Aquilae | 19 15.2 | − 5 36 | 5.1 | 0.110 | G7 | G7 | 2.6 | 0.032 | | |
| 4932 | 44 Sagittarii | 19 15.9 | −18 2 | 4.0 | 0.031 | A8 | ..... | 1.7 | 0.035 | 0.049 | M |
| 4940 | τ Draconis | 19 17.5 | +73 10 | 4.6 | 0.176 | K4 | K3 | 0.5 | 0.015 | | |
| 4950 | 31 Aquilae | 19 20.2 | +11 44 | 5.2 | 0.961 | G8 | G6 | 5.1 | 0.095 | 0.067 | A, M, Ye, *et al.* |
| 4953 | δ Aquilae | 19 20.5 | + 2 55 | 3.4 | 0.265 | A9 | ..... | 1.8 | 0.048 | 0.057 | A, M |
| 4961 | ..... | 19 21.3 | +24 44 | 6.2 | 0.658 | F6 | F4 | 3.9 | 0.035 | 0.060 | Y, Jo, F |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ..... | RR Lyrae § | 19h22m3 | +42°35′ | 7.3 | 0″.221‖ | Fop | F3 | 0.3 | 0″.004 | | |
| ..... | U Aquilae § | 19 24.0 | − 7 15 | 6.6 | 0.017‖ | Gop | F7 | −2.3 | 0.002 | | |
| 4976 | α Vulpeculae | 19 24.5 | +24 28 | 4.6 | 0.170 | Ma | Ko | 0.1 | 0.013 | | |
| 4978 | 8 Vulpeculae | 19 24.8 | +24 34 | 6.0 | 0.012 | G9 | G8 | 0.7 | 0.009 | | |
| 4985 | ..... | 19 26.4 | −28 13 | 7.0 | 0.741 | G6 | G4 | 5.8 | 0.058 | | |
| 4986 | $\beta^1$ Cygni | 19 26.7 | +27 45 | 3.2 | 0.009 | Ko | G6 | 0.8 | 0.033 | 0″.000 | A, M, Y |
| ..... | Bu. 9401 Br | 19 29.0 | +20 11 | 7.4† | 0.057* | A7 | ..... | 1.1 | 0.006 | −0.018 | A |
| 4995 | μ Aquilae | 19 29.2 | + 7 10 | 4.6 | 0.262 | K3 | K2 | 0.7 | 0.017 | 0.021 | A |
| C2554 | Groom. 2875 | 19 29.5 | +58 23 | 6.7 | 0.664 | K4 | K2 | 6.7 | 0.100 | 0.030 | A, Y |
| C2558 | Lal. 37120 | 19 29.7 | +32 59 | 6.6 | 0.517 | G1 | F9 | 4.4 | 0.036 | 0.043 | A, M, Y |
| 5005 | ..... | 19 31.7 | +51 1 | 5.8 | 0.205 | F6 | F6 | 3.3 | 0.032 | | |
| ..... | U Vulpeculae § | 19 32.3 | +20 7 | 7.0 | 0.031‖ | Gop | F9 | −2.0 | 0.002 | | |
| 5009 | σ Draconis | 19 32.6 | +69 29 | 4.8 | 1.840 | G9 | G7 | 5.8 | 0.158 | 0.192 | M, Y, P, *et al.* |
| 5014 | θ Cygni | 19 33.8 | +49 59 | 4.6 | 0.249 | F2 | F5 | 3.4 | 0.058 | 0.070 | A, M, Y, *et al.* |
| 5019 | 54 Sagittarii | 19 35.0 | −16 31 | 5.4 | 0.085 | K1 | Ko | 1.7 | 0.018 | | |
| 5021 | φ Cygni | 19 35.4 | +29 55 | 4.8 | 0.035 | G8 | G8 | 0.9 | 0.017 | | |
| 5023 | α Sagittae | 19 35.6 | +17 47 | 4.4 | 0.036 | F9 | F8 | −0.9 | 0.009 | −0.004 | M |
| 5027 | β Sagittae | 19 36.6 | +17 15 | 4.4 | 0.038 | G8 | G7 | 0.0 | 0.013 | | |
| 5031 | ..... | 19 37.8 | +45 17 | 5.0 | 0.142 | F4 | F4 | 1.5 | 0.020 | −0.003 | Y |
| 5033 | χ Aquilae | 19 37.9 | +11 35 | 5.6† | 0.013 | F5 | F7 | 2.4 | 0.023 | | |
| 5037 | $16^1$ Cygni | 19 39.2 | +50 18 | 6.3 | 0.217 | G2 | G1 | 5.1 | 0.058 | 0.038 | A, M, S, Ye |
| 5038 | $16^2$ Cygni | 19 39.2 | +50 17 | 6.4 | 0.204 | G3 | G3 | 4.6 | 0.044 | | |
| ..... | Bu. 9569 | 19 39.8 | +26 53 | 6.6 | 0.062 | Go | F9 | 1.8 | 0.011 | −0.010 | A |
| 5043 | ..... | 19 40.4 | +41 32 | 6.0 | 0.017* | K6 | K2 | 0.4 | 0.008 | 0.006 | W |
| 5044 | 56 Sagittarii | 19 40.5 | −20 0 | 5.1 | 0.165 | Ko | G9 | 1.7 | 0.021 | | |
| 5045 | 15 Cygni | 19 40.7 | +37 7 | 5.0 | 0.076 | G7 | G7 | 0.1 | 0.011 | 0.020 | A |
| ..... | SU Cygni § | 19 40.8 | +29 1 | 6.6 | ..... | F7p | F5 | −1.1 | 0.003 | | |
| 5047 | γ Aquilae | 19 41.5 | +10 22 | 2.8 | 0.014 | K3 | G5 | 0.3 | 0.032 | 0.034 | M |
| C2579 | Bu. 9602 | 19 41.8 | +33 22 | 9.2† | 0.433 | K4 | K2 | 6.7 | 0.032 | 0.041 | M |
| 5051 | 17 Cygni Br | 19 42.6 | +33 30 | 5.0 | 0.452 | F6 | F5 | 2.9 | 0.038 | 0.045 | A, M, Y |
| 5051 | 17 Cygni Ft | 19 42.6 | +33 30 | 8.1 | 0.452 | K4 | K2 | 6.5 | 0.048 | | |

TABLE VII—*Continued*

| Boss | Name | α 1900 | δ 1900 | Harv. Vis. Mag. | μ | Spectrum | | Spect. Abs. Mag. | Spect. π | Trig. π | Auth. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Est. | Meas. | | | | |
| 5052 | δ Sagittae | $19^h42^m.9$ | +18° 17′ | 3.8 | 0″.009 | Ma | G1 | 0.2 | 0″.019 | | |
| C2585 | Bu. 9650 | 19 45.0 | +35 4 | 6.9† | 0.119 | F4 | F4 | 3.1 | 0.017 | 0″.021 | S |
| 5063 | | 19 45.9 | +38 27 | 6.2 | 0.016 | G3 | G3 | −0.5 | 0.005 | | |
| 5071 | η Aquilae § | 19 47.4 | + 0 45 | 4.1 | 0.012 | F9p | F9 | −2.7 | 0.004 | 0.004 | M |
| 5075 | 20 Cygni | 19 48.1 | +52 44 | 5.2 | 0.072 | K5 | K3 | 0.2 | 0.010 | 0.020 | Ab |
| 5079 | ε Draconis | 19 48.5 | +70 1 | 4.0 | 0.087 | G2 | G5 | 0.7 | 0.022 | | |
| 5082 | 56 Aquilae | 19 48.7 | − 8 50 | 6.0 | 0.022 | K4 | K2 | 0.9 | 0.010 | | |
| 5089 | ξ Aquilae | 19 49.4 | + 8 12 | 4.9 | 0.126 | G9 | G9 | 0.8 | 0.015 | 0.039 | M |
| 5093 | β Aquilae | 19 50.4 | + 6 9 | 3.9 | 0.484 | G8 | G7 | 3.9 | 0.100 | 0.076 | A, M, S |
| 5096 | | 19 51.2 | +36 44 | 5.8 | 0.008 | F6 | F6 | 0.9 | 0.011 | | |
| 5098 | S Sagittae § | 19 51.5 | +16 22 | 5.8 | 0.004 | G1p | F8 | −2.5 | 0.002 | | |
| 5103 | η Cygni | 19 52.6 | +34 49 | 4.0 | 0.052 | K0 | G9 | 1.8 | 0.036 | | |
| 5116 | | 19 54.0 | +58 35 | 5.1 | 0.025 | K5 | K1 | 0.4 | 0.012 | | |
| 5118 | γ Sagittae | 19 54.3 | +19 13 | 3.7 | 0.062 | K6 | K2 | 0.5 | 0.023 | 0.005 | A |
| 5119 | | 19 54.4 | −10 13 | 5.9 | 0.488 | F8 | F8 | 4.2 | 0.046 | −0.004 | Y |
| C2607 | Lal. 38139 | 19 55.5 | −12 31 | 7.6 | 0.504 | F6 | F6 | 4.5 | 0.024 | | |
| 5125 | 13 Sagittae | 19 55.6 | +17 15 | 5.6 | 0.015 | Mc | G6 | 0.5 | 0.010 | | |
| 5129 | 62 Sagittarii | 19 56.5 | −27 59 | 4.6 | 0.037 | Mb | G7 | 0.3 | 0.014 | | |
| C2616 | Lal. 38287 | 19 58.0 | +15 20 | 7.2 | 0.608 | G8 | G5 | 5.6 | 0.048 | 0.085 | M, Y |
| 5142 | 62 Aquilae | 19 59.2 | − 0 59 | 5.8 | 0.119 | K1 | G7 | 1.7 | 0.015 | | |
| 5143 | τ Aquilae | 19 59.3 | + 7 0 | 5.6 | 0.025 | G8 | G7 | 0.0 | 0.008 | | |
| 5144 | | 19 59.5 | +29 38 | 5.7 | 0.853 | G7 | G7 | 4.8 | 0.066 | 0.049 | A, Y, F |
| 5146 | 15 Sagittae | 19 59.6 | +16 48 | 5.9 | 0.578 | G1 | G0 | 5.0 | 0.066 | 0.104 | Y, Jo |
| C2620 | Lal. 38383 | 19 59.7 | +23 5 | 7.2 | 1.369 | K2 | K0 | 6.6 | 0.076 | 0.059 | A, M, Y, *et al.* |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5149 | 64 Draconis | 20h 0m.4 | +64° 32′ | 5.4 | 0″.015 | Ma | G8 | −0.1 | 0″.008 | | |
| 5153 | ρ Draconis | 20 2.4 | +67 35 | 4.7 | 0.051 | K2 | K1 | 0.7 | 0.016 | | |
| 5157 | 27 Cygni | 20 2.6 | +35 42 | 5.5 | 0.496 | G8 | G6 | 4.1 | 0.052 | 0″.050 | Ye |
| 5163 | | 20 3.6 | +52 52 | 5.7 | 0.334 | F4 | F4 | 3.9 | 0.044 | 0.066 | Ab, Y |
| | B.D. +36° 3883 | 20 3.7 | +36 17 | 7.1 | | Ma | G7 | 1.0 | 0.006 | −0.004 | M |
| 5166 | | 20 4.6 | −36 21 | 5.3 | 1.626 | K3 | K0 | 6.7 | 0.190 | | |
| 5167 | 17 Sagittae C | 20 5.5 | +20 36 | 7.3 | 0.011 | K1 | K0 | 2.9 | 0.013 | 0.028 | S |
| 5169 | 17 Sagittae A | 20 5.5 | +20 37 | 6.3 | 0.111 | F2 | F2 | 3.0 | 0.022 | 0.019 | S |
| C2634 | Pi. 20h23 | 20 6.6 | +15 53 | 7.3 | 0.578 | K2 | K1 | 6.0 | 0.055 | 0.065 | Y, M |
| 5176 | 2 Capricorni | 20 6.9 | −12 55 | 5.9 | 0.269 | F4 | F4 | 3.8 | 0.038 | | |
| | Bu. 9979 | 20 7.1 | +43 39 | 7.7† | | G5 | G3 | 5.1 | 0.030 | 0.049 | S |
| 5177 | 19 Vulpeculae | 20 7.6 | +26 31 | 5.8 | 0.020 | K3 | G8 | 0.5 | 0.009 | | |
| | A.G. Berlin 8022 | 20 8.2 | +15 47 | 7.6 | 0.016 | F6 | F7 | 3.4 | 0.014 | | |
| 5180 | | 20 9.1 | −27 20 | 5.7 | 1.256 | K2 | K2 | 5.9 | 0.110 | 0.042 | F, V |
| 5184 | 68 Draconis | 20 9.9 | +61 47 | 5.7 | 0.155 | F6 | F5 | 3.0 | 0.029 | 0.037 | W |
| 5187 | $o^2$ Cygni | 20 10.5 | +46 26 | 4.0 | 0.002 | G9p | G1 | −2.0 | 0.006 | −0.002 | A, M |
| C2645 | Bu. 10044 A | 20 11.0 | +52 49 | 7.2† | 0.179 | F5 | F7 | 3.4 | 0.017 | 0.016 | A |
| 5197 | $\alpha^1$ Capricorni § | 20 12.1 | −12 49 | 4.6 | 0.015 | G0p | F7 | −3.9 | 0.002 | −0.012 | M |
| 5201 | 24 Vulpeculae | 20 12.5 | +24 22 | 5.4 | 0.027 | G7 | G5 | 0.5 | 0.011 | −0.027 | A |
| 5202 | $\alpha^2$ Capricorni | 20 12.5 | −12 51 | 3.8 | 0.058 | G8 | G6 | 1.2 | 0.030 | −0.012 | M |
| 5206 | σ Capricorni | 20 13.6 | −19 26 | 5.5 | 0.011 | K2 | K0 | 1.3 | 0.014 | | |
| 5216 | β Capricorni | 20 15.4 | −15 6 | 3.2 | 0.035 | F8 | F7 | 0.3 | 0.026 | 0.007 | M |
| | Bu. 10135 Ft | 20 15.9 | +55 5 | 7.4 | 0.021 | F3 | F3 | 2.8 | 0.012 | | |
| 5219 | | 20 16.5 | +66 32 | 6.1 | 0.557 | G2 | G1 | 5.2 | 0.066 | 0.120 | Y, J |
| C2654 | A.Oe. 20452 | 20 17.7 | −21 40 | 8.2 | 1.182 | F6 | F7 | 3.7 | 0.013 | 0.044 | F, V |
| 5229 | γ Cygni § | 20 18.6 | +39 56 | 2.3 | 0.003 | G0p | G0 | −3.0 | 0.009 | 0.014 | A, M, Y, F |
| 5231 | | 20 19.2 | +40 42 | 6.1 | 0.054 | K6 | K0 | 0.2 | 0.007 | | |
| 5235 | 39 Cygni | 20 19.9 | +31 52 | 4.6 | 0.041 | K5 | K2 | 0.5 | 0.015 | | |
| 5244 | ρ Capricorni A § | 20 23.2 | −18 9 | 5.1 | 0.026 | A9 | F0 | −1.0 | 0.010 | 0.024 | M |
| 5255 | 41 Cygni § | 20 25.3 | +30 2 | 4.1 | 0.010 | F6 | F4 | −1.1 | 0.009 | −0.018 | M |

TABLE VII—*Continued*

| Boss | Name | α 1900 | δ 1900 | Harv. Vis. Mag. | μ | Spectrum | | Spect. Abs. Mag. | Spect. π | Trig. π | Auth |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Est. | Meas. | | | | |
| 5256 | | $20^h25^m5$ | −15°23′ | 6.2 | 0″.073 | G2 | G2 | −0.2 | 0″.005 | | |
| 5263 | | 20 26.9 | −10 12 | 5.8 | 0.317 | G3 | G2 | 4.9 | 0.066 | 0″.035 | F |
| 5267 | 44 Cygni | 20 27.2 | +36 36 | 6.3 | 0.013 | F6 | F6 | 0.8 | 0.008 | | |
| 5276 | | 20 29.5 | +56 26 | 6.3 | 0.021 | K4 | K0 | 0.8 | 0.008 | | |
| C2667 | Groom. 3215 | 20 29.3 | +41 33 | 7.0 | 0.475 | K0 | G7 | 6.0 | 0.063 | 0.017 | A, Y, Jo |
| 5280 | | 20 30.4 | +72 12 | 6.4 | 0.025 | K4 | K2 | 0.8 | 0.008 | | |
| 5284 | 70 Aquilae | 20 31.5 | − 2 54 | 5.2 | 0.011 | K4 | G8 | 1.0 | 0.014 | | |
| | V Vulpeculae § | 20 32.3 | +26 11 | 8.6 | | G7p | G9 | −0.8 | 0.001 | | |
| 5291 | β Delphini | 20 32.9 | +14 15 | 4.0† | 0.113 | F3 | F5 | 2.3 | 0.046 | 0.027 | M, S, Ye, F |
| C2672 | Lal. 39816 | 20 34.2 | −24 8 | 6.3 | 0.658 | G8 | G7 | 6.2 | 0.095 | | |
| 5304 | κ Delphini | 20 34.3 | + 9 44 | 5.2 | 0.315 | G2 | G1 | 3.4 | 0.044 | | |
| 5305 | 1 Aquarii | 20 34.3 | + 0 8 | 5.4 | 0.094 | G9 | G9 | 1.6 | 0.017 | | |
| C2673 | Groom. 3243 | 20 34.4 | +42 29 | 7.1 | 0.197 | F6 | F6 | 3.2 | 0.017 | 0.000 | A |
| 5306 | υ Capricorni | 20 34.4 | −18 29 | 5.3 | 0.035 | Ma | G7 | 0.2 | 0.010 | | |
| C2676 | Lal. 39866 | 20 34.6 | + 4 37 | 8.4 | 0.844 | K5 | K4 | 8.0 | 0.083 | 0.061 | A, Ye, Y |
| 5317 | 10 Delphini | 20 36.6 | +14 14 | 6.2 | 0.012 | K3 | K0 | 1.0 | 0.009 | | |
| 5319 | 49 Cygni | 20 37.0 | +31 57 | 5.9† | 0.018 | G8 | G4 | 0.0 | 0.007 | | |
| | A.G. Berlin 8332 | 20 37.6 | +19 30 | 7.5 | 0.009 | K1 | G8 | 2.0 | 0.008 | | |
| 5321 | | 20 38.2 | +60 9 | 6.0 | 0.186 | F5 | F6 | 3.6 | 0.033 | 0.049 | Y, Ab |
| | X Cygni § | 20 39.5 | +35 14 | 6.5 | 0.018 | G3p | G0 | −2.1 | 0.002 | 0.006 | S |
| | A.G. Leiden 8454 | 20 41.1 | +31 25 | 8.0 | 0.015 | K1 | G9 | 1.5 | 0.005 | | |
| 5331 | 52 Cygni | 20 41.5 | +30 21 | 4.3 | 0.027 | G8 | G7 | 1.2 | 0.024 | 0.014 | M |
| | Bu. 10504 Br. | 20 41.5 | +15 32 | 7.5 | 0.121* | G8 | G6 | 5.5 | 0.040 | 0.016 | A |
| | Bu. 10504 Ft. | 20 41.5 | +15 32 | 8.2 | 0.100* | G6 | G7 | 5.3 | 0.026 | | |
| 5334 | $\gamma^1$ Delphini Ft. | 20 42.0 | +15 46 | 5.5 | 0.195 | F6 | F7 | 3.0 | 0.032 | 0.026 | M, S |
| 5335 | $\gamma^2$ Delphini Br. | 20 42.0 | +15 46 | 4.5 | 0.207 | K1 | K1 | 1.1 | 0.021 | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5336 | $\epsilon$ Cygni | $20^h42^m.2$ | $+33°36'$ | 2.6 | 0".483 | G7 | G7 | 0.8 | 0".044 | 0".036 | A, M, F, J |
| 5338 | 3 Aquarii | 20 42.5 | − 5 24 | 4.6 | 0.039 | Ma | Ko | 0.4 | 0.014 | | |
| 5344 | | 20 42.9 | +57 13 | 4.6 | 0.241 | F8 | F8 | 3.5 | 0.060 | 0.032 | A, Y |
| 5346 | $\eta$ Cephei | 20 43.3 | +61 27 | 3.6 | 0.826 | G8 | G8 | 3.2 | 0.083 | 0.092 | A, M, Ye, *et al.* |
| 5370 | T Vulpeculae § | 20 47.2 | +27 53 | 5.8 | 0.015 | F9 | F7 | −1.7 | 0.003 | | |
| 5373 | 31 Vulpeculae | 20 47.8 | +26 43 | 4.8 | 0.103 | G2 | G3 | −1.6 | 0.005 | | |
| 5379 | 32 Vulpeculae | 20 50.3 | +27 41 | 5.2 | 0.009 | K5 | K3 | 0.5 | 0.012 | | |
| 5385 | 17 Delphini | 20 50.9 | +13 20 | 5.4 | 0.023 | Ko | G7 | 0.4 | 0.010 | | |
| C2707 | A.Oe. 21338 | 20 51.3 | +61 48 | 8.6 | 0.77 | Ma | K5 | 9.4 | 0.144 | 0.139 | A |
| 5388 | | 20 52.1 | +80 11 | 5.6 | 0.040 | Ko | G9 | 1.6 | 0.016 | | |
| C2709 | Fed. 3638 | 20 52.4 | +74 23 | 7.9 | 0.691 | G6 | G4 | 5.3 | 0.030 | 0.015 | A Y, F |
| | Groom. 3359 | 20 53.6 | +69 34 | 7.8 | 0.020 | G9 | G5 | 1.7 | 0.006 | | |
| 5397 | 33 Vulpeculae | 20 53.8 | +21 56 | 5.6 | 0.005 | K4 | Ko | 1.0 | 0.012 | | |
| 5399 | $\epsilon$ Equulei AB | 20 54.1 | + 3 55 | 6.0† | 0.191 | F1 | F4 | 2.4 | 0.019 | 0.019 | M, S |
| 5399 | $\epsilon$ Equulei C | 20 54.1 | + 3 55 | 7.4 | ..... | F2 | F2 | 3.3 | 0.015 | | |
| 5409 | Bu. 10659 | 20 55.9 | +18 56 | 6.2† | 0.075 | Ma | K1 | 0.5 | 0.007 | 0.009 | W |
| C2718 | Groom. 3357 | 20 56.1 | +39 52 | 6.6 | 0.314 | F7 | F8 | 3.9 | 0.039 | 0.040 | Ye, Jo |
| | A.G. Leiden 8661 | 20 58.8 | +31 57 | 7.2 | 0.014‡ | K4 | G9 | 0.5 | 0.005 | | |
| C2728 | W.B. $20^h1454$ | 20 59.1 | + 2 36 | 8.1 | 0.485 | F6 | F7 | 3.9 | 0.014 | −0.015 | M, Y |
| 5420 | | 20 59.2 | +38 16 | 6.2 | 0.012 | G8 | G6 | 1.5 | 0.012 | | |
| 5422 | 3 Equulei | 20 59.6 | + 5 6 | 5.9 | 0.019 | K3 | Ko | 1.0 | 0.011 | | |
| C2732 | Lal. 40844 | 21 0.4 | + 6 41 | 8.9 | 0.553 | K7 | K5 | 8.7 | 0.091 | 0.081 | Ye, Y |
| 5430 | 24 Capricorni | 21 1.3 | −25 24 | 4.6 | 0.059 | K4 | K1 | 0.7 | 0.017 | | |
| 5431 | $\xi$ Cygni § | 21 1.3 | +43 32 | 3.9 | 0.007 | K2p | G5 | −2.9 | 0.004 | −0.003 | A |
| 5432 | | 21 2.3 | +30 47 | 5.9 | 0.010 | F7 | F6 | 0.7 | 0.009 | | |
| 5433 | $61^1$ Cygni | 21 2.4 | +38 15 | 5.6 | 5.267 | K7 | K7 | 8.3 | 0.347 | 0.307 | A, M, W, *et al* |
| 5434 | $61^2$ Cygni | 21 2.4 | +38 15 | 6.3 | 5.153 | K8 | K7 | 8.7 | 0.302 | | |
| 5441 | $\nu$ Aquarii | 21 4.1 | −11 47 | 4.5 | 0.094 | G8 | G8 | 2.0 | 0.032 | | |
| ..... | A.G. Leiden 8741 | 21 4.9 | +32 22 | 8.1 | 0.023‡ | Ko | G6 | 2.4 | 0.007 | | |

TABLE VII—*Continued*

| Boss | Name | α 1900 | δ 1900 | Harv. Vis. Mag. | μ | Spectrum | | Spect. Abs. Mag. | Spect. π | Trig. π | Auth |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Est. | Meas. | | | | |
| ..... | B.D. +38° 4362..... | 21h 5m2 | +38°19′ | 7.8 | ..... | K2 | G9 | 1.7 | 0″.006 | −0″.031 | R |
| 5443..... | γ Equulei..... | 21 5.5 | + 9 44 | 4.8 | 0″.169 | Fo | Fo | −0.4 | 0.009 | | |
| C2749..... | W.B. 21h97..... | 21 7.4 | +17 21 | 7.3 | 0.915 | F4 | F3 | 4.0 | 0.022 | 0.032 | A, Y, F, J |
| 5452..... | ζ Cygni..... | 21 8.7 | +29 49 | 3.4 | 0.059 | G6 | G7 | −1.1 | 0.013 | 0.026 | A, M |
| C2753..... | Fed. 3738..... | 21 8.8 | +73 18 | 8.6 | 0.518 | Ko | K1 | 6.1 | 0.032 | | |
| 5455..... | δ Equulei AB..... | 21 9.6 | + 9 36 | 5.1† | 0.306 | F6 | F7 | 4.0 | 0.060 | 0.053 | M, F, Hus |
| 5456..... | φ Capricorni..... | 21 9.9 | −21 4 | 5.4 | 0.007 | K2 | G8 | 1.1 | 0.014 | | |
| 5457..... | 29 Capricorni..... | 21 10.2 | −15 35 | 5.5 | 0.019 | Mb | G9 | 0.4 | 0.010 | | |
| 5460..... | τ Cygni..... | 21 10.8 | +37 37 | 3.8 | 0.455 | F1 | F3 | 1.9 | 0.042 | 0.042 | A, M, S, *et al.* |
| 5461..... | α Equulei..... | 21 10.8 | + 4 50 | 4.1 | 0.104 | F6 | F7 | 1.9 | 0.036 | 0.034 | A |
| C2763..... | Lal. 41348..... | 21 12.9 | − 0 15 | 8.6 | 0.476 | K5 | K3 | 7.0 | 0.048 | | |
| ..... | A.G. Berlin 8683..... | 21 13.8 | +17 18 | 7.6 | 0.022‡ | K1 | G9 | 1.5 | 0.006 | | |
| ..... | A.G. Berlin 8684..... | 21 13.9 | +17 34 | 7.2 | 0.016‡ | F4 | F3 | 3.5 | 0.018 | | |
| C2769..... | Bu. 10881 Br..... | 21 14.0 | −26 46 | 6.6† | 0.665 | G8 | G5 | 5.6 | 0.063 | −0.100 | F |
| 5476..... | 16 Aquarii..... | 21 15.8 | − 4 59 | 6.0 | 0.026 | G7 | G6 | 1.6 | 0.013 | | |
| 5481..... | ..... | 21 16.5 | +58 12 | 5.8 | 0.014 | F3 | F7 | 1.7 | 0.015 | | |
| 5482..... | 34 Vulpeculae..... | 21 16.6 | +23 26 | 5.8 | 0.253 | G9 | G9 | 0.6 | 0.009 | | |
| 5486..... | ..... | 21 16.8 | +76 35 | 6.2 | 0.020 | K4 | K1 | 0.5 | 0.007 | | |
| 5489..... | 1 Pegasi..... | 21 17.5 | +19 23 | 4.2 | 0.118 | Ko | Ko | 1.4 | 0.028 | 0.020 | A, Ye |
| 5490..... | 17 Aquarii..... | 21 17.6 | − 9 45 | 6.2 | 0.050 | K4 | K2 | 0.8 | 0.008 | | |
| ..... | A.G. Berlin 8723..... | 21 18.4 | +16 4 | 7.6 | 0.022‡ | K4 | Ko | 1.1 | 0.005 | | |
| ..... | A.G. Bonn 15400..... | 21 18.6 | +41 26 | 9.1 | ..... | K3 | K1 | 1.2 | 0.003 | | |
| 5507..... | ζ Capricorni §..... | 21 21.0 | −22 51 | 3.9 | 0.023 | G1p | F9 | −3.9 | 0.003 | | |
| 5519..... | ..... | 21 23.9 | +31 47 | 5.7 | 0.134 | Fo | F1 | 2.9 | 0.028 | 0.032 | W |
| C2790..... | W.B. 21h502..... | 21 24.5 | −12 56 | 9.4 | 1.052 | K6 | K6 | 8.5 | 0.066 | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5522 | 2 Pegasi | $21^h25^m.4$ | +23° 12′ | 4.8 | 0″.017 | K4 | K2 | 0.6 | 0″.014 | | |
| 5523 | 71 Cygni | 21 25.8 | +46 6 | 5.3 | 0.114 | G9 | G8 | 1.5 | 0.017 | 0″.036 | A, S, Ye, Ab |
| C2797 | W.B. $21^h594$ | 21 26.0 | +45 27 | 7.9 | 0.056 | G8 | G7 | 5.6 | 0.035 | 0.025 | A |
| 5527 | β Aquarii § | 21 26.3 | − 6 1 | 3.1 | 0.017 | F9 | F8 | −2.1 | 0.009 | −0.016 | M, F |
| | B.D. +45° 3566 | 21 26.8 | +46 6 | 8.3 | ..... | Fo | Fo | 2.0 | 0.006 | | |
| | Groom. 3502 | 21 30.0 | +67 56 | 8.7 | 0.027 | K2 | Ko | 2.1 | 0.005 | | |
| 5542 | | 21 30.1 | − 4 26 | 5.8 | 0.021 | Ko | G8 | −0.1: | 0.007 | | |
| 5543 | ρ Cygni | 21 30.2 | +45 9 | 4.2 | 0.099 | G5 | G4 | 1.3 | 0.026 | 0.013 | A, Ab, Y |
| 5546 | 72 Cygni | 21 30.7 | +38 5 | 5.0 | 0.148 | G9 | Ko | 0.6 | 0.013 | 0.003 | A, Y |
| | A.G. Leiden 9045 | 21 33.8 | +32 41 | 7.6 | 0.045‡ | G8 | G7 | 1.2 | 0.005 | | |
| 5559 | 24 Aquarii | 21 34.4 | − 0 30 | 7.4† | 0.236 | F8 | F7 | 4.0 | 0.021 | 0.017 | F, J |
| 5560 | 25 Aquarii | 21 34.5 | + 1 48 | 5.3 | 0.088 | Ko | G9 | 1.9 | 0.021 | | |
| 5562 | γ Capricorni § | 21 34.6 | −17 7 | 3.8 | 0.188 | F4 | F4 | −0.7 | 0.013 | 0.018 | M |
| | A.G. Leiden 9056 | 21 35.1 | +31 5 | 8.2 | 0.047 | F8 | F8 | 3.0 | 0.009 | | |
| 5566 | 42 Capricorni | 21 36.1 | −14 30 | 5.3 | 0.331 | Go | G1 | 3.8 | 0.050 | | |
| 5569 | 26 Aquarii | 21 37.1 | + 0 50 | 5.8 | 0.015 | K2 | G9 | 1.0 | 0.011 | | |
| 5570 | κ Capricorni | 21 37.1 | −19 19 | 4.8 | 0.142 | G2 | G3 | −1.4 | 0.006 | | |
| 5583 | | 21 39.1 | +40 42 | 5.5 | 0.026 | Ma | G9 | 0.3 | 0.009 | | |
| 5584 | ε Pegasi | 21 39.3 | + 9 25 | 2.5 | 0.025 | Ko | G4 | −0.3 | 0.028 | 0.006 | A, M, F |
| 5587 | $\mu^1$ Cygni A | 21 39.7 | +28 18 | 4.7 | 0.370 | F5 | F6 | 3.5 | 0.058 | 0.046 | M |
| 5589 | 46 Capricorni | 21 39.7 | − 9 33 | 5.3 | 0.010 | G7 | G6 | −0.1 | 0.008 | | |
| C2823 | A.G. Berlin 8366 | 21 39.7 | +24 53 | 9.1 | 0.65 | Ko | G7 | 6.1 | 0.025 | | |
| 5590 | 9 Pegasi | 21 39.8 | +16 53 | 4.5 | 0.029 | G5 | Go | −0.6 | 0.010 | | |
| 5591 | | 21 39.9 | +28 19 | 7.6† | 0.061 | A9 | ..... | 2.3 | 0.009 | | |
| 5592 | κ Pegasi | 21 40.1 | +25 11 | 5.3† | 0.033 | F2 | F5 | 2.7 | 0.030 | 0.038 | A, M, S, *et al* |
| 5593 | μ Cephei | 21 40.4 | +58 19 | 4.5 | 0.002 | Ma | G8 | 0.3 | 0.014 | 0.010 | A |
| 5594 | 11 Cephei | 21 40.5 | +70 51 | 4.8 | 0.153 | K1 | K1 | 0.6 | 0.014 | | |
| 5595 | 47 Capricorni | 21 40.9 | − 9 44 | 6.2 | 0.016 | Mb | G7 | 0.1 | 0.006 | | |
| 5599 | 12 Pegasi | 21 41.5 | +22 29 | 5.4 | 0.016 | Ko | G2 | 1.5 | 0.017 | | |
| 5602 | | 21 41.8 | +25 6 | 6.5 | 0.148 | K1 | K2 | 1.9 | 0.012 | 0.005 | W |

TABLE VII—*Continued*

| Boss | Name | α 1900 | δ 1900 | Harv. Vis. Mag. | μ | Spectrum | | Spect. Abs. Mag. | Spect. π | Trig. π | Auth |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Est. | Meas. | | | | |
| 5614 | 12 Cephei | $21^h44^m.5$ | +60°14′ | 5.6 | 0″.006 | K5 | K3 | 0.5 | 0″.010 | | |
| 5616 | 13 Pegasi | 21 45.4 | +16 49 | 5.3 | 0.096 | A 8 | ..... | 1.4 | 0.015 | | |
| ..... | A.G. Leiden 9158 | 21 46.5 | +32 12 | 8.6 | ..... | Ko | G6 | 3.3 | 0.009 | | |
| ..... | Groom. 3594 | 21 47.2 | +64 46 | 7.9 | 0.010‡ | Mb | G6 | 0.8 | 0.004 | | |
| ..... | A.G. Leiden 9164 | 21 47.3 | +31 27 | 7.5 | 0.029‡ | K4 | K2 | 0.9 | 0.005 | | |
| 5623 | μ Capricorni | 21 47.8 | −14 1 | 5.2 | 0.308 | A9 | F2 | 1.9 | 0.022 | | |
| ..... | Groom. 3604 | 21 48.7 | +66 22 | 8.2 | 0.014 | F2 | F3 | 3.3 | 0.011 | | |
| 5638 | ..... | 21 51.4 | +53 28 | 6.9 | 0.172 | F6 | F7 | 3.2 | 0.018 | 0″.014 | A |
| 5645 | ..... | 21 53.2 | −21 40 | 6.2 | 0.015 | Mb | G7 | 0.7 | 0.008 | | |
| 5650 | ..... | 21 53.8 | +63 9 | 5.4 | 0.012 | Mdp | ..... | −0.3 | 0.007 | | |
| 5651 | ..... | 21 54.3 | +29 21 | 6.8 | 0.540 | F6 | F4 | 4.1 | 0.029 | 0.040 | S, Y, F, J |
| 5655 | 28 Aquarii | 21 56.0 | + 0 7 | 5.8 | 0.006 | K4 | K2 | 1.2 | 0.012 | | |
| 5657 | 19 Pegasi | 21 56.2 | + 7 47 | 5.8 | 0.022 | K4 | K1 | 1.0 | 0.011 | | |
| 5658 | 20 Pegasi | 21 56.2 | +12 38 | 5.7 | 0.077 | F3 | F3 | 2.3 | 0.021 | | |
| 5661 | 16 Cephei | 21 57.8 | +72 42 | 5.2 | 0.174 | F3 | F3 | 2.6 | 0.030 | 0.038 | A |
| 5671 | 32 Aquarii | 21 59.6 | − 1 23 | 5.2 | 0.045 | A9 | ..... | 1.0 | 0.014 | | |
| 5674 | ν Pegasi | 22 0.6 | + 4 34 | 4.9 | 0.144 | K6 | K3 | 0.3 | 0.012 | 0.016 | A, M |
| 5676 | α Aquarii § | 22 0.6 | − 0 48 | 3.2 | 0.015 | Go | F8 | −2.8 | 0.006 | 0.010 | M |
| 5677 | ξ¹ Cephei Ft | 22 0.9 | +64 8 | 6.5 | 0.226 | F7 | F7 | 3.9 | 0.030 | 0.029 | A |
| 5682 | Bu. 11514 Br | 22 1.8 | +82 23 | 7.1 | 0.141 | F6 | F6 | 3.5 | 0.019 | 0.006 | W |
| 5683 | Bu. 11514 Ft | 22 1.9 | +82 23 | 7.8† | 0.142 | G3 | G4 | 4.8 | 0.025 | | |
| 5688 | ι Pegasi | 22 2.4 | +24 51 | 4.0 | 0.299 | F4 | F6 | 3.6 | 0.083 | 0.079 | A, M, S |
| 5691 | ..... | 22 2.7 | +18 59 | 5.8 | 0.126 | F1 | F5 | 2.4 | 0.021 | 0.013 | W |
| C2885 | Groom. 3689 | 22 3.1 | +52 39 | 7.9 | 0.629 | K1 | G7 | 4.8 | 0.024 | 0.051 | Ye, Y, F, J |
| 5694 | ..... | 22 3.8 | +58 21 | 6.3 | 0.030 | G6 | G5 | 1.0 | 0.009 | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5707 | | $22^h\ 5^m.3$ | $-4°46'$ | 6.1 | 0".063 | G9 | G7 | 1.1 | 0".010 | | |
| 5709 | $\pi$ Pegasi | 22 5.5 | +32 41 | 4.4 | 0.026 | A9 | ..... | 0.3 | 0.015 | 0".005 | A |
| 5714 | $\zeta$ Cephei | 22 7.4 | +57 42 | 3.6 | 0.012 | K2 | G4 | 0.5 | 0.024 | 0.026 | A, M |
| 5716 | 24 Cephei | 22 7.9 | +71 51 | 5.0 | 0.028 | G2 | G3 | −2.0 | 0.004 | | |
| 5721 | | 22 8.2 | +56 21 | 5.4 | 0.270 | F6 | F7 | 3.4 | 0.040 | 0.027 | A |
| 5723 | | 22 8.4 | +69 38 | 5.5 | 0.058 | F2 | F2 | 2.6 | 0.026 | 0.084 | S |
| 5724 | | 22 8.4 | +34 7 | 5.4 | 0.047 | K2 | K1 | 0.8 | 0.012 | | |
| 5744 | $\theta$ Aquarii | 22 11.6 | −8 17 | 4.3 | 0.112 | G5 | G7 | −0.7 | 0.010 | | |
| 5745 | | 22 11.6 | −9 32 | 6.1 | 0.053 | K3 | K1 | 0.8 | 0.009 | | |
| 5746 | 1 Lacertae | 22 11.6 | +37 15 | 4.2 | 0.020 | K3 | K1 | 0.4 | 0.017 | 0.005 | A |
| 5749 | 44 Aquarii | 22 11.9 | −5 53 | 5.8 | 0.020 | G5 | G4 | −0.4 | 0.006 | | |
| C2903 | Lal. 43492 | 22 12.3 | +12 24 | 7.0 | 0.853 | G1 | G0 | 5.7 | 0.055 | 0.038 | A, M, Y, *et al.* |
| 5752 | 45 Aquarii | 22 13.6 | −13 48 | 6.1 | 0.074 | G9 | G9 | 1.7 | 0.013 | | |
| 5769 | | 22 18.3 | −7 42 | 6.1 | 0.006 | G6 | G6 | 0.6 | 0.008 | | |
| 5772 | 33 Pegasi | 22 18.8 | +20 21 | 6.1 | 0.338 | F4 | F5 | 4.1 | 0.040 | 0.060 | W |
| 5776 | $\beta$ Lacertae | 22 19.6 | +51 44 | 4.6 | 0.190 | G8 | G8 | 2.1 | 0.032 | 0.017 | A |
| 5782 | $53^2$ Aquarii A | 22 21.1 | −17 15 | 6.4 | 0.225 | G1 | G1 | 4.3 | 0.038 | | |
| 5786 | 34 Pegasi | 22 21.5 | +3 53 | 5.8 | 0.295 | F7 | F7 | 3.9 | 0.042 | 0.067 | F, J |
| 5790 | 35 Pegasi | 22 22.8 | +4 12 | 4.9 | 0.325 | K0 | G0 | 1.8 | 0.024 | 0.033 | A |
| ..... | Groom. 3781 | 22 23.1 | +69 23 | 8.0 | 0.019 | G7 | G5 | 2.3 | 0.007 | | |
| ..... | A. G. Berlin 9185 | 22 23.4 | +16 45 | 7.5 | 0.017‡ | K0 | G8 | 2.2 | 0.009 | | |
| 5793 | $\zeta^1$ Aquarii | 22 23.7 | −0 32 | 4.6 | 0.173 | F2 | F2 | 1.6 | 0.025 | 0.036 | M |
| 5794 | $\zeta^2$ Aquarii | 22 23.7 | −0 32 | 4.4 | 0.212 | F2 | F4 | 1.6 | 0.028 | | |
| C2922 | Krüger 60 A | 22 24.4 | +57 11 | 9.3† | 0.87 | Mb | ..... | 10.8 | 0.200 | 0.261 | M, Ye, R, Bar |
| 5800 | 37 Pegasi | 22 24.9 | +3 55 | 5.7† | 0.141 | F1 | F2 | 0.9 | 0.011 | | |
| 5804 | 5 Lacertae § | 22 25.4 | +47 12 | 4.6 | 0.021 | K2p | G4 | −2.8 | 0.003 | 0.005 | A |
| 5807 | $\delta$ Cephei § | 22 25.5 | +57 54 | 4.1 | 0.012 | G0 | F9 | −2.7 | 0.004 | 0.011 | A |
| ..... | Groom. 3813 | 22 27.1 | +75 43 | 7.9 | 0.009‡ | K1 | G8 | 1.7 | 0.006 | | |
| 5822 | | 22 30.1 | −24 30 | 6.0 | 0.016 | K0 | G7 | 1.1 | 0.011 | | |
| C2937 | A.G. Albany 7817 | 22 30.5 | +4 52 | 8.4 | 0.45 | G1 | G2 | 4.1 | 0.014 | | |

TABLE VII—*Continued*

| Boss | Name | α 1900 | δ 1900 | Harv. Vis. Mag. | μ | Spectrum | | Spect. Abs. Mag. | Spect. π | Trig. π | Auth. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Est. | Meas. | | | | |
| 5835 | κ Aquarii | $22^h32^m6$ | − 4°45′ | 5.3 | 0″.138 | K2 | K1 | 0.8 | 0″.013 | | |
| 5838 | 31 Cephei | 22 33.3 | +73 7 | 5.2 | 0.171 | F2 | F3 | 0.2 | 0.010 | −0″.034 | Y |
| 5851 | Bu. 11895 | 22 35.9 | +14 1 | 6.6† | 0.302 | G4 | G5 | 4.5 | 0.038 | | |
| 5852 | 11 Lacertae | 22 36.1 | +43 45 | 4.6 | 0.097 | K2 | K0 | 0.7 | 0.017 | | |
| 5865 | η Pegasi | 22 38.3 | +29 42 | 3.1 | 0.036 | G1 | G3 | −0.2 | 0.022 | −0.003 | A, M, S, F |
| 5868 | Bu. 11936 A | 22 39.6 | +38 56 | 6.2† | 0.016 | K4 | K2 | 0.4 | 0.007 | 0.006 | W |
| 5868 | Bu. 11936 B | 22 39.6 | +38 56 | 8.3 | 0.016 | G8 | G8 | 1.5 | 0.004 | | |
| C2968 | Pi. $22^h214$ | 22 40.9 | +29 56 | 6.5 | 0.461 | K0 | G8 | 4.8 | 0.046 | 0.015 | Ye, Y |
| 5874 | ξ Pegasi | 22 41.7 | +11 40 | 4.3 | 0.545 | F5 | F6 | 3.8 | 0.079 | 0.058 | A, M, Y |
| 5875 | λ Pegasi | 22 41.7 | +23 2 | 4.1 | 0.060 | G7 | G6 | −0.3 | 0.013 | 0.037 | A |
| 5878 | 68 Aquarii | 22 42.2 | −20 8 | 5.4 | 0.237 | G6 | G6 | 1.4 | 0.016 | | |
| 5884 | τ Aquarii | 22 44.3 | −14 7 | 4.2 | 0.039 | K5 | K2 | 0.5 | 0.018 | | |
| 5885 | μ Pegasi | 22 45.2 | +24 4 | 3.7 | 0.154 | G7 | G6 | 1.1 | 0.030 | 0.024 | A, M |
| 5891 | ι Cephei | 22 46.1 | +65 40 | 3.7 | 0.139 | K0 | G9 | 1.1 | 0.030 | 0.042 | A, M |
| 5892 | | 22 46.4 | +13 26 | 8.0 | 0.474 | K2 | K1 | 6.3 | 0.046 | 0.150 | J |
| 5894 | σ Pegasi | 22 47.3 | + 9 18 | 5.3 | 0.516 | F4 | F6 | 3.2 | 0.038 | 0.042 | Ye, Y, F |
| 5895 | λ Aquarii | 22 47.4 | − 8 7 | 3.8 | 0.036 | Ma | G9 | 0.3 | 0.020 | | |
| 5899 | 34 H Cephei | 22 47.9 | +82 37 | 5.0 | 0.064 | K2 | K0 | 1.6 | 0.021 | | |
| 5909 | Bu. 12046 | 22 50.0 | − 5 31 | 6.0† | 0.018 | G8 | G6 | 1.7 | 0.014 | | |
| 5914 | | 22 52.0 | +49 12 | 5.1 | 0.012 | K2 | K5 | 0.8 | 0.014 | | |
| 5915 | | 22 52.1 | − 5 21 | 6.4 | 0.023 | G6 | G7 | 1.5 | 0.011 | | |
| 5917 | 51 Pegasi | 22 52.6 | +20 14 | 5.6 | 0.210 | G4 | G3 | 4.6 | 0.063 | | |
| 5920 | Bu. 12090 | 22 53.5 | + 8 50 | 7.0† | 0.420 | G0 | F9 | 4.2 | 0.028 | | |
| 5923 | | 22 54.3 | −13 36 | 6.3 | 0.014 | K3 | K0 | 0.4 | 0.007 | | |
| C3001 | Lal. 44964 | 22 55.0 | −23 4 | 7.7 | 0.899 | K4 | K1 | 7.2 | 0.079 | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C3002 | A.G. Chris. 3703 | $22^h55^m1$ | +68° 29′ | 8.4 | 0″.066 | Ko | G8 | 5.6 | 0″.028 | | |
| 5927 | 36 H Cephei | 22 55.2 | +83 49 | 5.0 | 0.106 | K5 | K2 | 0.4 | 0.012 | | |
| 5931 | B.D. +56° 2923 § | 22 55.9 | +56 25 | 5.5 | 0.009 | G2p | G2 | −2.6 | 0.002 | | |
| C3007 | Lal. 45028 | 22 56.7 | − 4 23 | 7.6 | 0.478 | K3 | K3 | 6.1 | 0.050 | 0″.053 | M, Y |
| 5940 | β Pegasi | 22 58.9 | +27 32 | 2.6 | 0.234 | Mb | G7 | 0.0 | 0.030 | 0.000 | A, M, J, F |
| 5942 | 3 Androm. | 22 59.7 | +49 30 | 4.9 | 0.230 | G9 | G8 | 1.3 | 0.019 | −0.004 | A |
| C3019 | Fed. 4371 | 23 1.2 | +67 52 | 7.5 | 0.615 | G6 | G1 | 5.7 | 0.044 | 0.056 | Y |
| 5950 | 86 Aquarii | 23 1.3 | −24 17 | 4.8 | 0.068 | G5 | G6 | 1.2 | 0.019 | | |
| 5952 | 55 Pegasi | 23 2.0 | + 8 52 | 4.7 | 0.016 | Ma | K4 | 0.3 | 0.013 | 0.005 | A |
| 5954 | 56 Pegasi | 23 2.2 | +24 56 | 5.0 | 0.038 | Kop | G2 | 1.9 | 0.025 | | |
| 5958 | 5 Androm. | 23 3.2 | +48 45 | 5.8 | 0.194 | F6 | F5 | 3.4 | 0.033 | | |
| C3028 | Lal. 45292 | 23 4.0 | − 2 48 | 8.3 | 0.587 | K4 | K3 | 6.5 | 0.044 | 0.035 | Y |
| 5962 | 57 Pegasi | 23 4.5 | + 8 8 | 5.4 | 0.004 | Mb | G3 | 0.2 | 0.009 | | |
| 5963 | 89 Aquarii § | 23 4.6 | −23 0 | 4.9 | 0.013 | F8 | F9 | −0.7 | 0.008 | | |
| 5966 | π Cephei | 23 4.7 | +74 51 | 4.7† | 0.028 | G2 | G1 | −0.2 | 0.011 | −0.014 | S |
| 5972 | 6 Androm. | 23 5.8 | +43 0 | 5.8 | 0.275 | F5 | F4 | 3.7 | 0.038 | | |
| 5975 | 7 Androm. | 23 8.0 | +48 52 | 4.6 | 0.134 | Fo | Fo | 2.3 | 0.035 | 0.048 | A, M |
| 5976 | | 23 8.5 | +56 37 | 5.6 | 2.102 | K5 | K5 | 7.2 | 0.209 | 0.172 | S, J, P, F |
| 5977 | Bu. 12234 Br. | 23 8.9 | − 9 28 | 8.3 | 0.557 | F5 | F7 | 3.9 | 0.013 | 0.019 | Y |
| | Bu. 12234 Ft. | 23 8.9 | − 9 28 | 9.4 | 0.557 | G2 | G3 | 5.6 | 0.017 | | |
| 5978 | φ Aquarii | 23 9.1 | − 6 35 | 4.4 | 0.193 | K9 | K2 | 0.6 | 0.017 | | |
| 5981 | 91 Aquarii | 23 10.7 | − 9 38 | 4.5 | 0.367 | Ko | G9 | 1.4 | 0.024 | | |
| 5982 | 61 Pegasi | 23 10.9 | +27 42 | 6.5 | 0.015 | G3 | F9 | 0.0 | 0.005 | | |
| 5988 | γ Piscium | 23 12.0 | + 2 44 | 3.8 | 0.753 | G5 | G4 | 0.5 | 0.022 | 0.021 | A, M, Y |
| 5989 | | 23 12.1 | +52 40 | 5.6 | 0.270 | F8 | F8 | 3.9 | 0.046 | 0.049 | W |
| 5993 | 8 Androm. | 23 13.1 | +48 28 | 5.0 | 0.038 | Ma | G9 | 0.2 | 0.011 | | |
| C3053 | Bu. 12290 | 23 13.8 | + 4 52 | 9.0† | 0.492 | K2 | G9 | 6.4 | 0.030 | 0.011 | M, Ye, Y, J |
| 5998 | 94 Aquarii | 23 13.9 | −14 0 | 5.3 | 0.314 | G5 | G5 | 2.1 | 0.023 | | |
| 5999 | 96 Aquarii | 23 14.2 | − 5 40 | 5.7 | 0.193 | F1 | F2 | 2.7 | 0.025 | | |
| 6000 | o Cephei | 23 14.5 | +67 34 | 5.0† | 0.066 | G7 | G7 | 0.7 | 0.014 | 0.032 | A |

TABLE VII—*Continued*

| Boss | Name | α 1900 | δ 1900 | Harv. Vis. Mag. | μ | Spectrum | | Spect. Abs. Mag. | Spect. π | Trig. π | Auth. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Est. | Meas. | | | | |
| C3054 | W.B. $23^h257$ | $23^h15^m0$ | +28°19′ | 8.8 | 0″.66 | K1 | K0 | 6.2 | 0″.030 | 0″.061 | Ye |
| 6002 | | 23 15.0 | +47 50 | 6.4 | 0.206 | K1 | K0 | 1.0 | 0.008 | | |
| C3059 | Lal. 45755 | 23 16.8 | +43 33 | 7.6 | 0.671 | K0 | G7 | 6.0 | 0.048 | 0.039 | Y, R |
| 6012 | 98 Aquarii | 23 17.7 | −20 39 | 4.2 | 0.153 | K0 | G8 | 1.6 | 0.030 | | |
| 6016 | | 23 18.1 | +59 35 | 5.9 | 0.003 | K4 | G8 | 0.5 | 0.008 | | |
| 6020 | | 23 18.9 | +31 59 | 6.5 | 0.233 | A9 | F3 | 2.3 | 0.014 | | |
| 6024 | υ Pegasi | 23 20.4 | +22 51 | 4.6 | 0.191 | F6 | F7 | 1.3 | 0.022 | 0.025 | A, M |
| | A.G. Cam. 8232 | 23 21.0 | +52 26 | 6.9 | | Mb | G9 | 0.5 | 0.005 | | |
| | A.G. Bonn 17799 | 23 22.6 | +43 19 | 8.0 | | K2 | K1 | 1.5 | 0.005 | | |
| 6040 | 70 Pegasi | 23 24.1 | +12 13 | 4.7 | 0.062 | G6 | G5 | 0.5 | 0.014 | | |
| 6042 | | 23 24.4 | − 5 5 | 6.4 | 0.283 | K5 | K4 | 0.6 | 0.007 | | |
| | Grcom. 4079 | 23 25.8 | +43 25 | 8.1 | 0.009 | K0 | G7 | 2.8 | 0.009 | | |
| 6048 | d'Agelet 6348 | 23 26.4 | − 4 38 | 6.5 | 0.247 | F8 | F9 | 3.6 | 0.026 | | |
| 6049 | 14 Androm. | 23 26.4 | +38 41 | 5.3 | 0.294 | G9 | G7 | 1.5 | 0.017 | | |
| C3081 | A.Oe. 25685 | 23 26.5 | +58 37 | 6.8 | 1.06 | K0 | K0 | 5.6 | 0.058 | 0.075 | Y |
| C3085 | A.Oe. 25734 | 23 28.2 | +62 36 | 7.4 | 0.42 | G4 | G3 | 4.0 | 0.021 | −0.012 | Y |
| 6059 | 72 Pegasi | 23 29.0 | +30 46 | 6.0† | 0.053 | K4 | K2 | 0.7 | 0.009 | | |
| | Groom. 4094 | 23 29.3 | +73 40 | 8.0 | 0.013 | G8 | G5 | 2.0 | 0.006 | | |
| C3096 | d'Agelet 6348 | 23 31.0 | +17 53 | 8.0 | 0.702 | G5 | G5 | 5.7 | 0.035 | | |
| 6071 | λ Androm | 23 32.7 | +45 55 | 4.0 | 0.449 | G8 | G5 | 2.5 | 0.050 | 0.028 | A, Y |
| 6077 | ι Piscium | 23 34.8 | + 5 5 | 4.3 | 0.574 | F4 | F7 | 3.9 | 0.083 | 0.098 | M, Y, J |
| 6078 | γ Cephei | 23 35.2 | +77 4 | 3.4 | 0.169 | K1 | K1 | 2.3 | 0.060 | 0.070 | Ye |
| | Groom. 4129 | 23 36.9 | +75 2 | 8.0 | 0.028 | G9 | G7 | 2.5 | 0.008 | | |
| 6089 | 77 Pegasi | 23 38.3 | + 9 47 | 5.4 | 0.007 | Ma | G6 | −0.1 | 0.008 | | |
| C3115 | Pi. $23^h164$ | 23 38.5 | +57 31 | 7.0 | 0.610 | G2 | F9 | 4.7 | 0.035 | −0.062 | Y, F |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 6094 | 78 Pegasi | $23^h39^m0$ | +28°48′ | 5.0 | 0″080 | G7 | G7 | 1.1 | 0″017 | | |
| 6097 | | 23 39.9 | +55 15 | 6.6 | 0.029 | G6 | G6 | 0.3 | 0.006 | 0″008 | W |
| C3117 | W.B. $23^h819$ | 23 40.0 | +29 0 | 8.9 | 0.91 | K1 | K1 | 6.2 | 0.029 | | |
| 6101 | $\psi$ Androm | 23 41.1 | +45 52 | 5.1 | 0.022 | G5p | Go | −3.8 | 0.002 | | |
| 6105 | Lal. 46607 | 23 42.1 | +56 54 | 5.8 | 0.021 | K3 | G8 | 0.3 | 0.008 | | |
| 6106 | $\tau$ Cassiop | 23 42.2 | +58 6 | 5.1 | 0.087 | Ko | G9 | 0.4 | 0.012 | | |
| 6109 | | 23 43.4 | − 6 56 | 6.3 | 0.026 | K1 | G9 | 1.6 | 0.012 | | |
| C3124 | Lal. 46650 | 23 44.0 | + 1 52 | 8.7 | 1.393 | Ma | K4 | 10.1 | 0.190 | 0.182 | Ye, Y, R, *et al.* |
| C3126 | A.G. Albany 8170 | 23 44.9 | + 2 19 | 8.4 | 0.499 | G8 | G5 | 4.6 | 0.017 | 0.027 | Ye, R |
| 6123 | 22 Piscium | 23 46.8 | + 2 22 | 5.8 | 0.020 | K4 | Ko | 0.7 | 0.010 | | |
| 6124 | | 23 47.2 | +77 3 | 6.5 | 0.278 | F2 | F4 | 3.4 | 0.024 | | |
| 6127 | $\phi$ Pegasi | 23 47.4 | +18 34 | 5.2 | 0.047 | Ma | Ko | 0.4 | 0.011 | 0.014 | A |
| 6129 | | 23 47.5 | +74 59 | 6.6 | 0.332 | K3 | K3 | 6.7 | 0.105 | 0.097 | A, M, W |
| 6135 | $\rho$ Cassiop. § | 23 49.4 | +56 57 | 4.8 | 0.007 | G5p | G4 | −3.3 | 0.002 | 0.032 | A, M. |
| C3131 | Lal. 46867 | 23 49.9 | +28 5 | 7.3 | 0.573 | K2 | K3 | 6.0 | 0.055 | | |
| | Grcom. 4170 | 23 51.4 | +73 35 | 8.2 | 0.020 | K2 | K1 | 1.4 | 0.004 | | |
| 6145 | | 23 52.0 | +42 6 | 6.0 | 0.012 | F6 | F4 | 1.7 | 0.014 | | |
| 6150 | $\psi$ Pegasi | 23 52.7 | +24 35 | 4.8 | 0.056 | Ma | G8 | 0.1 | 0.012 | | |
| 6151 | | 23 53.0 | +49 53 | 6.8 | 0.245 | G4 | G4 | 5.0 | 0.044 | | |
| 6156 | $\omega$ Piscium | 23 54.2 | + 6 19 | 4.0 | 0.186 | F3 | F4 | 2.3 | 0.046 | 0.013 | A, M |
| | B.D. +26° 4721 | 23 54.2 | +26 43 | 8.3 | ..... | G9 | G6 | 2.1 | 0.006 | 0.006 | F |
| C3146 | A.Oe. 23166 | 23 54.3 | −20 35 | 7.4 | 0.608 | G5 | G4 | 5.7 | 0.046 | | |
| 6171 | 30 Piscium | 23 56.8 | − 6 34 | 4.7 | 0.053 | Mb | G7 | 0.0 | 0.012 | | |
| 6172 | 85 Pegasi A | 23 56.9 | +26 33 | 5.8 | 1.291 | G3 | G2 | 5.6 | 0.091 | 0.096 | A, S, Ye, *et al.* |
| 6176 | Bu. 12704 Br | 23 57.5 | +65 33 | 5.8 | 0.018 | G8 | G7 | 0.8 | 0.010 | | |
| C3162 | Pi. $23^h267$ | 23 59.7 | +34 6 | 6.2 | 0.766 | G1 | Go | 4.3 | 0.042 | 0.033 | A, Y |

## NOTES

SX Cassiopeiae. Period 36.5 days. Enhanced line spectrum similar to α Cygni. Hydrogen lines Hβ and Hγ have bright edges.

A.G. Bonn 4686. Proper motion from Groombridge.

Boss 1622. Estimates made from plates lent by the Lick Observatory.

Bu. 3474. Proper motion by Batterman.

Comp. α Geminorum. Bu. 4122C, distant 72″. A spectroscopic binary having bright hydrogen lines.

Lal. 15389. Proper motion by Bossert.

S Antliae. Short-period variable. Period $=0^{d}32$. Spectrum lines extremely poor, probably indicating rapid rotation. Secondary component suspected.

W Ursae Majoris. Algol variable. Period 8 hours. Both spectral components show. Lines very wide due to rapid rotation of the two stars.

Boss 2830. A close visual and spectroscopic binary. Estimates made from plates taken by Sanford at the Mills Station of the Lick Observatory.

Boss 3735. Estimates from plates lent by the Lick Observatory.

Bu. 7001. Proper motion from Greenwich.

Boss 3846. Spectrum lines very poor, resembling those of W Ursae Majoris.

Bu. 8068A. Proper motion from Porter.

7:1917 Serpentis. Peculiar variable discovered by Wolf and Barnard. Hβ bright.

W Serpentis. Spectrum shows doubly reversed bright hydrogen lines.

Bu. 9401 Br. Proper motion from A.G. Berlin.

Bu. 9569. Proper motion from Auwers.

Bu. 10504 Br. and Ft. Proper motion from A.G. Berlin.

MOUNT WILSON OBSERVATORY
October 1920

# THE SPECTROSCOPIC ORBIT OF THE CEPHEID VARIABLE X CYGNI[1]

By JOHN C. DUNCAN

ABSTRACT

*Cepheid variable X Cygni.*—A brief summary of previous observations relating to this variable is given. From twenty-three spectrograms made at Mount Wilson with the 60-inch reflector and single-prism spectrograph, the *elements of the spectroscopic orbit* have been computed. The values of $K$ (28 km/sec.), of $a \sin i$ (6,121,000 km), and of the mass-function (0.034) are remarkably large. The probable error for a plate is large in comparison with the deviations in the measures of a single plate made by different observers; but there is no evidence of a secondary oscillation.

The variable star X Cygni ($\alpha = 20^h 39^m.5$, $\delta = +35°14'$; 1900.0) was discovered by S. C. Chandler[2] in 1886. Of a number of published determinations of its photometric elements, the best is probably that of M. Luizet,[3] which is based on observations covering 554 periods and made by eight different observers. Luizet gives as the time of maximum brightness

J.D. 2410190.684 (Paris M.T.)+16$^d$.38543 E,

and finds that, though the maxima and minima are repeated with regularity, the amount of the change of light is not constant, the magnitude at maximum ranging from 6.5 to 6.2, and at minimum from 7.4 to 7.2. Secondary oscillations appear in both the rising and the falling branches of the curve. The duration of the increase of light is 6$^d$.1.

The spectrum as classified at the Harvard Observatory is F5, peculiar. Like other Cepheids, the star is bluer and has stronger hydrogen lines at maximum brilliancy than at minimum. The variation in the radial velocity was discovered by Frost.[4]

Table I gives a list of the spectrograms of X Cygni taken at the Mount Wilson Observatory. They were made by Messrs. Adams, Joy, Strömberg, Sanford, Merrill, and Duncan, with the

[1] *Contributions from the Mount Wilson Observatory*, No. 196.

[2] *Astronomical Journal*, **7**, 32, 1886.

[3] *Astronomische Nachrichten*, **193**, 83, 1912.

[4] *Astrophysical Journal*, **25**, 60, 1907.

60-inch reflector and single-prism spectrograph, using the 18-inch camera. All were measured by Miss Brayton and Mr. Duncan, and some also by Miss Burwell and Messrs. Adams, Joy, Strömberg, and Sanford. No systematic differences in the measures were found, and the column headed "Velocity" gives the mean results, reduced to the sun. The Greenwich mean time given in Table I refers to the middle of the exposure. The phase is the number of days after maximum light according to the elements of Luizet.

TABLE I

| Plate Number | Date | G.M.T. | J.D., G.M.T. | Phase | Velocity | O−C | Number of Measures |
|---|---|---|---|---|---|---|---|
| | | | | | km/sec. | km/sec. | |
| 6353.. | 1917 Nov. 3 | $16^h03^m$ | 242 1536.669 | $7^d.273$ | +16.2 | −2.2 | 6 |
| 6358.. | 4 | 18 05 | 1537.754 | 8.358 | +24.2 | −0.8 | 5 |
| 7213.. | 1918 Aug. 17 | 22 31 | 1823.939 | 15.991 | −14.8 | −0.9 | 4 |
| 8261.. | 1919 June 8 | 22 05 | 2118.920 | 16.034 | −17.4 | +0.2 | 2 |
| 8329.. | July 3 | 22 01 | 2143.918 | 8.261 | +26.2 | +2.0 | 2 |
| 8336.. | 5 | 21 12 | 2145.884 | 10.227 | +40.4 | +6.6 | 2 |
| 8341.. | 7 | 22 15 | 2147.927 | 12.270 | +31.0 | −3.0 | 2 |
| 8348.. | 8 | 22 49 | 2148.951 | 13.294 | +27.7 | +2.5 | 2 |
| 8357.. | 10 | 20 57 | 2150.858 | 15.201 | − 6.6 | −0.4 | 3 |
| 8363.. | 11 | 20 39 | 2151.861 | 16.302 | −23.0 | 0.0 | 2 |
| 8370.. | 12 | 20 10 | 2152.841 | 0.798 | −17.4 | +2.6 | 2 |
| 8375.. | 13 | 19 46 | 2153.824 | 1.781 | −16.6 | +0.6 | 2 |
| 8387.. | 14 | 22 16 | 2154.928 | 2.885 | − 7.2 | +3.8 | 2 |
| 8400.. | 15 | 22 03 | 2155.919 | 3.876 | − 6.0 | −1.5 | 2 |
| 8412.. | 17 | 18 50 | 2157.868 | 5.825 | + 5.0 | −3.9 | 3 |
| 8436.. | 19 | 18 13 | 2159.843 | 7.800 | +20.0 | −1.7 | 2 |
| 8478.. | Aug. 6 | 21 14 | 2177.885 | 9.457 | +34.2 | +3.5 | 2 |
| 8482.. | 7 | 18 46 | 2178.782 | 10.354 | +38.6 | +4.4 | 2 |
| 8522.. | 10 | 19 59 | 2181.832 | 13.404 | +23.7 | −0.1 | 2 |
| 8523.. | 10 | 21 11 | 2181.883 | 13.455 | +19.4 | −4.5 | 2 |
| 8545.. | 11 | 20 50 | 2182.868 | 14.440 | +14.4 | +7.3 | 2 |
| 8689.. | Sept. 10 | 15 55 | 2212.663 | 11.465 | +33.6 | −2.5 | 2 |
| 8692.. | 10 | 20 45 | 2212.865 | 11.667 | +32.0 | −3.6 | 2 |

Preliminary elements were derived by the method of Lehmann-Filhés. As no planimeter was available, the necessary areas were determined by tracing the velocity-curve on thin paper, cutting out the areas, and weighing them on a chemical balance. Luizet's photometric period was assumed as the orbital period, and there

appeared no good reason for changing it. The preliminary elements are:

$K = 28.0$ km/sec.
$\omega = 110°$
$e = 0.25$
$T = 15^d.0$ after light maximum
$\gamma = +9.5$ km/sec.

A least-squares solution was based on these elements, the observations being given equal weight and grouped to form eighteen

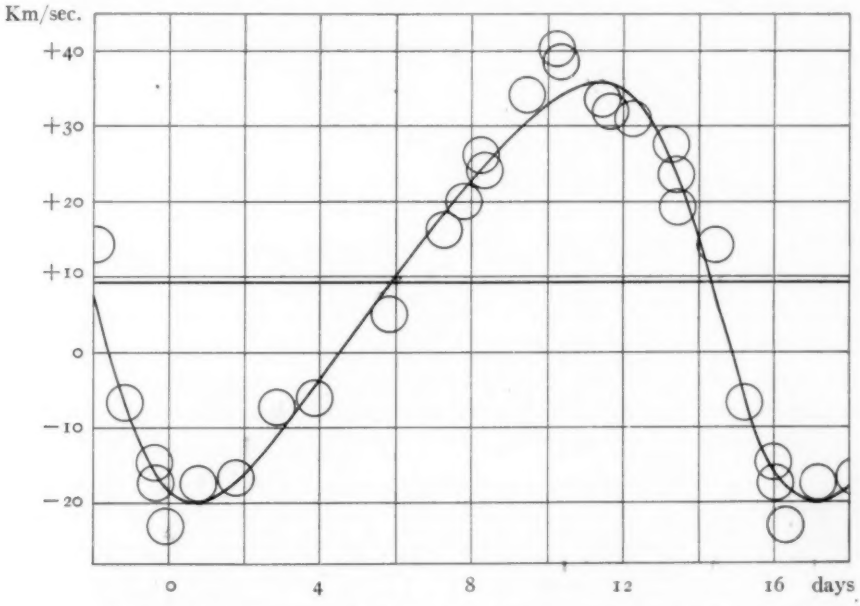


FIG. 1.—Velocity-curve of X Cygni. Abscissae are intervals after maximum light; the radius of the circles representing the observations is equal to the probable error of a single plate.

normal places. The period was not included in this solution. The following elements were thus obtained:

$K = 28.03 \pm 0.73$ km/sec.
$\omega = 98°.2 \pm 14°.9$
$e = 0.246 \pm 0.027$
$T = 14^d.557 \pm 0^d.523$
$\gamma = +9.32$ km/sec.

By the least-squares adjustment the sum of the squares of the residuals was reduced but slightly, from 78.07 to 76.24.

As $\omega$ and $T$ were the only elements greatly changed, and as they showed the greatest probable errors, a second solution was made with these as the only variables. The results were

$$\omega = 101.^{\circ}1 \pm 4.^{\circ}3,$$
$$T = 14.^{d}685 \pm 0.^{d}169.$$

The sum of the squares of the residuals was again slightly reduced, this time to 75.22. The finally adopted elements, from which the residuals given in Table I and the velocity-curve shown in Figure 1 were computed, are:

$$P = 16^{d}.38543$$
$$K = 28.03 \text{ km/sec.}$$
$$\omega = 101.^{\circ}1$$
$$e = 0.246$$
$$T = 14^{d}.685 \text{ after light maximum}$$
$$\gamma = +9.32 \text{ km/sec.}$$
$$a \sin i = 6{,}121{,}000 \text{ kilometers}$$
$$\frac{m_1^3 \sin^3 i}{(m+m_1)^2} = 0.034$$

Maximum negative velocity occurs $0^{d}.7$ after maximum brightness
Maximum positive velocity occurs $1^{d}.1$ after minimum brightness

The values of $K$, $a \sin i$, and the mass function are considerably larger than in the case of any other Cepheid which has been spectroscopically investigated. The probable error of a single plate, computed from the residuals in Table I, is $\pm 2.44$ km/sec., a value much larger than the good agreement of the different measures on each plate might have led one to expect. There seems, however, to be no good evidence of a secondary oscillation in a period commensurate with that of the principal one.

MOUNT WILSON OBSERVATORY
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# PROVISIONAL ELEMENTS OF THE ECLIPSING SYSTEM RS CANUM VENATICORUM

By BANCROFT WALKER SITTERLY

ABSTRACT

*Eclipsing binary RS Canum Venaticorum.—Provisional elements* for this system, B.D.+36°2344, have been computed on the basis of a series of observations made by Maggini in 1916. The light-curve (Fig. 1) shows extremely long minima which together take four-ninths of the whole period. The two giant stars apparently touch at periastron; they are elongated toward each other; and move in an orbit with an eccentricity of 0.17. The eclipses are either total or annular. The probable distance is 1200 light-years.

This discussion is based upon a series of observations made by Maggini upon the star B.D.+36°2344 by the Argelander method, and published by him in Volume **34** of the *Publications of the Arcetri Observatory*, Florence, in 1916. Although these observations do not define the star's light-curve with sufficient exactness to warrant great confidence in the elements obtained from it, the curve's form is so unusual in some respects that it was considered worth while to attempt a solution. The methods followed were those of Russell and Shapley, described in their contributions to the *Astrophysical Journal* in 1912 and 1913.

The striking features of the curve's form are: (1) minima of extremely long duration, in proportion to the length of the period, indicating that the stars are very close together; (2) a noticeable difference in the durations of the minima, suggesting a considerable ellipticity in the orbit; (3) a sharply bowed form of the curve between eclipses, denoting that the stars are elongated toward one another. The depths of the minima are also noteworthy, especially that of the secondary; they show that the stars are not very different in size and that they eclipse one another nearly totally.

The first step in the solution was to group Maggini's observations, which were means of five Argelander estimates each, and rather unequally spaced, into convenient normals. In most cases

Maggini's observations were paired, but a few were taken by threes and a few singly. Then the curve was "rectified," removing the effect of the elliptic figure of the stars, in the usual manner. The eccentricity of figure came out more than three-tenths, a value somewhat above the average. But the "rectified" curve was still not a horizontal straight line outside eclipses, as expected, but showed a brightening of the system toward primary minimum. Since the secondary minimum, though its middle point did not seem much displaced, was seen to last five hours longer than the primary (indicating a considerably eccentric orbit with periastron near the point of primary eclipse), this brightening was considered a heating effect caused by the approach of the stars to one another at periastron, and its effect was taken out of the curve by applying a correction $\Delta m = a \cos\theta + b \sin\theta$; setting $a = 0.05$ and $b = 0$ gave a satisfactory correction.

It was now found by trial that by advancing the epoch of primary minimum by $0^d.0074$ and retarding the secondary epoch by $0^d.0223$, the curve might be improved. This gave at once a value for the transverse component of the eccentricity of the orbit: $e \cos\omega = 0.02$; the determination is not very exact, for the secondary minimum is not well defined by the observations. The line-of-sight component is given by the ratio of the durations of the minima; after several trials the value $e \sin\omega = 0.167$ appeared to fit the two curves best, but this is even less accurately determined than $e \cos\omega$. The two values combined gave $e = 0.17$, $\omega =$ nearly $85°$.

Next, an approximation to the elements, from the shape of the primary minimum and the depths of both minima, was tried in the usual manner on the hypothesis of uniformly illuminated disks. It appeared at once from the steepness of the curve that the eclipses must be total or annular; in fact, the assumption that the orbit is exactly edge-on to our line of sight, so that the stars eclipse each other centrally, gave most satisfactory results. A preliminary solution made the fainter star two-thirds as bright as the other and one-fourth larger, the primary eclipse being total and the secondary annular. But the sum of the radii of the stars came out greater than the radius of the orbit, that is, the stars were in contact —a result difficult to reconcile with the form of the curve, but

demanded by the great duration of the minima. The two minima together occupy 45 per cent of the whole period.

Here we had a curious assembly of data. If the system were really two separate stars, the sum of the radii could not be greater than the periastron distance of centers in the orbit, but it could not be much less than this and even approximately fit the curves of minima. The hypothesis of central transit was necessitated by the form of the curve at primary minimum, which also determined the ratio of radii and proportionate luminosity of the two stars within narrow limits. It was therefore decided to *assume* elements in accordance with these data and compute a light-curve to fit them; then to compare this with the observations, and if necessary to repeat the process several times. Since the stars eclipsed one another centrally, it was a simple matter directly to compute the percentage of eclipse at any instant by means of the $p$-functions of Russell's method, even for the combination of "darkened" disks, eccentric orbit, and elliptic stars, which combination would present considerable complication if attacked as usual from the other end. Accordingly, for various percentages of obscuration during each eclipse, the distance of the centers of the stars was computed by the formula:

$$\text{distance of centers} = a_1 (1 + pk),$$

where $a_1$ is the longest radius of the larger star, $k$ the ratio of the stars' radii, and $p$ a function of $k$ and the percentage of obscuration, tabulated by Russell and Shapley. $a_1$ and $k$ were assumed as above stated. A curve was drawn for each minimum analogous to a light-curve, but with the loss of light plotted against the distance of centers instead of against the phase. To compare the observations with this curve the distance of the centers of the stars for the time of each normal was computed by the formula: $[r \cos (v+\omega)] [1 - z \cos^2 \theta]^{-\frac{1}{2}}$, in which $r$, the radius vector of the orbit, and $v$, the true anomaly, were computed from the previously chosen values $e = 0.17$, $\omega = 85°$, while the second factor is Russell's function to remove the effect of the ellipticity of the stars. This quantity, together with the observed loss of light, having been found for each normal, the normals were plotted with the

quasi-light-curve above mentioned and residuals directly read off. A few trials in this manner gave curves on both the "uniform" and "darkened" hypotheses.

TABLE I

RESIDUALS

| Normal | Weight | O−C Uniform | O−C Darkened | Normal | Weight | O−C Uniform | O−C Darkened |
|---|---|---|---|---|---|---|---|
| 1 | 2 | +0.01 | −0.01 | 21 | 2 | +0.04 | +0.01 |
| 2 | 2 | +0.02 | +0.08 | 22 | 2 | +0.07 | +0.04 |
| 3 | 2 | 0.00 | +0.06 | 23 | 2 | +0.04 | +0.04 |
| 4 | 2 | +0.03 | +0.09 | 24 | 2 | +0.01 | +0.01 |
| 5 | 2 | +0.03 | +0.09 | 25 | 2 | −0.05 | −0.05 |
| 6 | 2 | +0.04 | +0.10 | 26 | 2 | +0.02 | |
| 7 | 2 | 0.00 | +0.06 | 27 | 2 | 0.00 | |
| 8 | 2 | −0.01 | +0.04 | 28 | 3 | 0.00 | |
| 9 | 2 | −0.04 | +0.01 | 29 | 1 | −0.05 | |
| 10 | 2 | −0.04 | −0.01 | 30 | 3 | +0.02 | +0.02 |
| 11 | 2 | −0.07 | −0.05 | 31 | 2 | −0.04 | −0.01 |
| 12 | 2 | −0.01 | −0.01 | 32 | 2 | −0.11 | −0.06 |
| 13 | 2 | +0.01 | | 33 | 2 | −0.04 | +0.02 |
| 14 | 2 | +0.01 | | 34 | 3 | +0.08 | +0.13 |
| 15 | 1 | 0.00 | | 35 | 2 | +0.07 | +0.11 |
| 16 | 2 | −0.02 | −0.02 | 36 | 2 | −0.03 | +0.03 |
| 17 | 1 | +0.02 | +0.02 | 37 | 2 | −0.08 | 0.00 |
| 18 | 2 | +0.06 | +0.07 | 38 | 2 | −0.17 | −0.14 |
| 19 | 3 | +0.02 | −0.01 | 39 | 2 | −0.08 | −0.11 |
| 20 | 2 | +0.05 | +0.02 | 40 | 1 | +0.01 | −0.03 |

Probable error of one normal of unit weight: { on "uniform" assumption, 0.04952 / on "darkened" assumption, 0.05577

Like the majority of eclipsing binaries, this system seems to have the brighter star the smaller, according to the "uniform" solution, but the larger by the "darkened" solution. The "uniform" curve, it may noted, fits a trifle better than the "darkened." These solutions, though each deviates considerably from the observed normals, represent them as closely as might be done without allowing the stars actually to coalesce. By the "uniform" solution, the stars just touch at periastron; by the "darkened" they are separated at that point by 0.003 of the major axis of the orbit. Neither supposition seems quite compatible with a stable system, but any diminishing of the stars'

radii leads to much increased deviation from the observational curve. More accurate observations might clear up the difficulty here, and seem very desirable, since the system appears to represent a very interesting stage in the evolution of binaries. A spectroscopic study would also shed much light on the true condition of the system, and seems perfectly feasible, since the maximum brightness is about $7^{M}.9$.

TABLE II

ELEMENTS

| Element | Symbol | Value | |
|---|---|---|---|
| | | Uniform | Darkened |
| Ratio of radii of stars | $k$ | 0.800 | 0.850 |
| Semi-major axis of brighter star | $a_b$ | 0.368 | 0.445 |
| Semi-major axis of fainter star | $a_f$ | 0.460 | 0.378 |
| Semi-minor axis of brighter star | $b_b$ | 0.338 | 0.423 |
| Semi-minor axis of fainter star | $b_f$ | 0.422 | 0.360 |
| Eccentricity of meridian section of stars | $\epsilon=\sqrt{z\ \mathrm{cosec}^2\ i}$ | 0.397 | 0.312 |
| Inclination of orbit | $i$ | 90° 0′ | 90° 0′ |
| Eccentricity of orbit | $e$ | 0.17 | |
| Longitude of periastron | $\omega$ | 85° 0′ | |
| Primary eclipse | ..... | Total | Annular |
| Secondary eclipse | ..... | Annular | Total |
| Ratio of brightness of stars at perihelion to brightness at aphelion | ..... | 1.09 | |
| Light in terms of system of brighter star | $L_b$ | 0.600 | 0.722 |
| Light in terms of system of fainter star | $L_f$ | 0.400 | 0.278 |
| Ratio of surface brightness of stars | $J_b/J_f$ | 2.34 | 1.87 |
| Density of brighter star in terms of sun | $\bar{\rho}_b$ | 0.025 | 0.014 |
| Density of fainter star in terms of sun | $\bar{\rho}_f$ | 0.013 | 0.023 |
| Semi-major axis of brighter star in terms of sun | $\bar{a}_b$ | 3.43 | 4.15 |
| Light of brighter in terms of sun | $\bar{L}_b$ | 75 | |
| Parallax | $\pi$ | 0″.003 | |
| Distance in light-years | ..... | 1200 | |
| Spectral type | ..... | F8 | |

Assuming that each star has the mass of the sun, the actual radii and dimensions in terms of the sun were computed. The densities come out considerably less than the sun's, indicating an earlier stage of evolution. Miss Cannon gives the spectrum as F8, and a computation of the probable brightness and parallax of the brighter component by Shapley's formulas shows this as one of the "giant" stars, seventy-five times as bright as the sun and more than a thousand light-years distant. Residuals of the

observations from the two computed curves are given herewith in Table I, and elements in Table II. Figure 1 gives the light-curves.

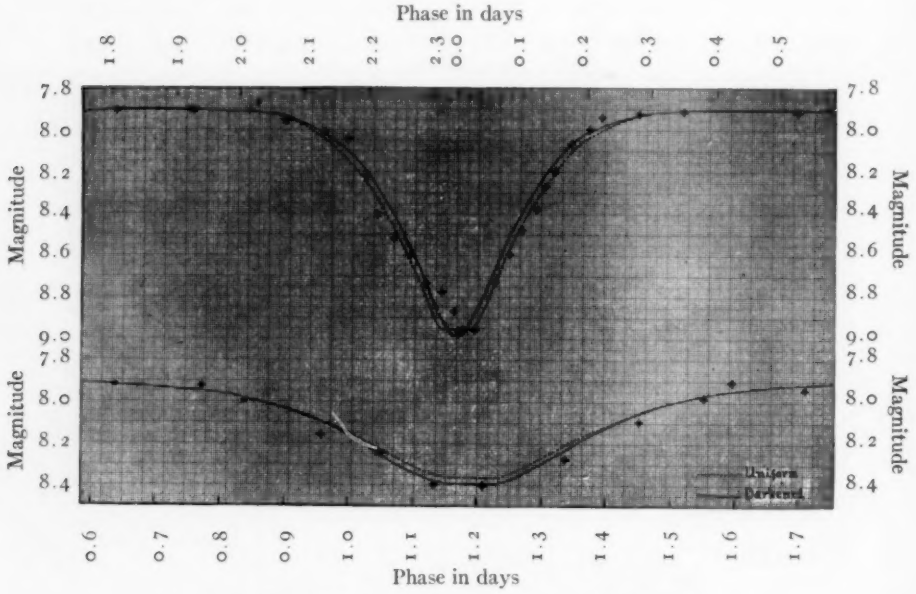


FIG. 1—Mean light-curve of RS Canum Venaticorum

In conclusion I wish to acknowledge my indebtedness to Professor Russell, of the Princeton Observatory, not only for the entire method of the solution but for his care in going over and correcting the work as it progressed.

PRINCETON UNIVERSITY OBSERVATORY
August 1920